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THESIS

REFOCUSING NATO's INTELLIGENCE OUTLOOK TOWARDS BIOLOGICAL WARFARE

by

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Today, we are attempting to manage chaos. With the end of the Cold War, a number of troubling developments in the world have been unleashed, especially the proliferation of WMD. Biological weapons are an increasing threat to world security. Nations and non-state actors are willing to sell or buy the necessary technologies for the production of biological weapons which can have disastrous effects on a military, an economy, and the environment. Despite major efforts in reducing worldwide nuclear and chemical capable threats, biological weapons require the same amount of attention if not more from the North Atlantic Treaty Organization. NATO must highlight the threat of biological warfare in current policies in order to educate political, military, and civilian leaders on biological warfare issues, deter the employment of biological weapons, and increase a sense of security within the Alliance. For far too long, the intelligence communities within the Alliance have definitely underestimated the biological programs of other nations and non-state actors.

Refocusing the intelligence communities towards biological warfare will be of an enormous advantage for the Alliance. Intelligence stems from the policies and directives set forth by worldwide governments. New policies will enhance the efforts of intelligence agencies and increase the awareness of the ominously growing biological warfare threat. Hopefully, if policies change, then intelligence communities will refocus their efforts towards the new change: the increasing threat of biological warfare.

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REFOCUSING NATO's INTELLIGENCE OUTLOOK TOWARDS BIOLOGICAL WARFARE

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ABSTRACT

Today, we are attempting to manage chaos. With the end of the Cold War, a number of troubling developments in the world have been unleashed, especially with the proliferation of WMD. Biological weapons are an increasing threat to world security. Nations and non-state actors are willing to buy or sell necessary technologies for the production of biological weapons which can have disastrous effects on a military, an economy, and the environment. Despite major efforts in reducing worldwide nuclear and chemical capable threats, biological weapons require the same amount of attention if not more from the North Atlantic Treaty Organization. NATO must highlight the threat of biological warfare in current policies in order to educate political, military, and civilian leaders on biological warfare issues, deter the employment of biological weapons, and increase a sense of security within the Alliance. For far too long, the intelligence communities within the Alliance have definitely underestimated the biological programs of other nations and non-state actors.

Refocusing the intelligence communities towards biological warfare will be of an enormous advantage for the Alliance. Intelligence stems from the policies and directives set forth by worldwide governments. New policies will enhance the efforts of intelligence agencies and increase the awareness of the ominously growing biological warfare threat. Hopefully, if policies change, then intelligence communities will refocus their efforts towards the new change: the increasing threat of biological warfare.

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EXECUTIVE SUMMARY

In April 1949, the North Atlantic treaty created a dynamic Alliance of independent states for the purpose of maintaining security and peace of its members. The Alliance was an unqualified success, but with the end of the Cold War, the Alliance is facing numerous challenges, especially from the rising proliferation of WMD and the specific knowledge of how to produce them. Too many sovereign states and individual groups are now willing to buy or sell the technologies necessary to produce biological weapons which could have disastrous effects on military institutions, a nation's economy, and the environment. WMD, along with the delivery systems, create an enormous risk for the member states and their forces and constitute a threat to international security. To provide the member states a stable security environment, NATO must face this dreadful challenge head on.

Despite major efforts in reducing nuclear and chemical capable threats throughout the world, biological weapons require the same amount of attention, if not more, from the Alliance. Nuclear and chemical weapons seem to receive most of the attention judging by publications and governmental policies while biological weapons are just "mentioned" in passing. The Alliance's intelligence communities have definitely underestimated the biological programs of other states and adversaries. Two primary examples are the miscalculated Iraqi biological weapons program and the Russian Biopreparat program.

When the Biological Weapons Convention was opened for signature in 1972, four nations were suspected of developing offensive biological weapons. In 1992, there were ten such nations. Now, there are 12 suspected nations actively involved in the development of offensive biological weapons.

One reason why NATO should expand all efforts against biological warfare is the potential hazards associated with biological agents. The world is battling against

the rise of infectious diseases and the biological agents seem to be winning. As nations or non-state actors observe the increasing problems created by biological agents, they will realize that such agents are an outstanding weapon of choice. The possession of biological agents for the use in biological weapons will have a direct impact on worldwide operations. Nations and non-state actors have accessibility to the necessary equipment for producing these agents and to the biological agents themselves. NATO cannot underestimate any nation or non-state actor's ability to develop biological weapons.

The second reason why NATO should expand all efforts against biological warfare is the threat of terrorist group activities involving biological weapons. As these dual use technologies spread throughout the world, the probability of biological terrorism will only increase. The threat of biological terrorism is increasing. These groups have illustrated their interest in all areas of biological agents, sophisticated biological equipment, and delivery systems over the past three decades.

Challenging the proliferation of biological weapons requires an enormous amount of attention from the Alliance. Many NATO platforms and forces could easily be targeted or attacked with biological weapons during peacetime or wartime operations. Refocusing the intelligence community towards biological warfare will be a great advantage for the Alliance. Intelligence exists because of the policies and directives established by worldwide governments. NATO must change its policies towards biological warfare. Will it take an offensive employment of a biological agent to include biological warfare in key documents? Or will it take mass casualties from a biological attack? New policies would enhance the efforts of intelligence agencies and increase the awareness of the biological warfare threat. If policies change, then intelligence will refocus their efforts towards the new change: the increasing threat of biological warfare.

I. INTRODUCTION

In April 1949, the North Atlantic treaty created a dynamic Alliance of independent states for the purpose of maintaining security and peace of its members. With the end of the Cold War, the Alliance will face numerous challenges, especially from the rising proliferation of weapons of mass destruction (WMD) and the specific knowledge of how to manufacture them. When states and individual groups are willing to purchase or sell the technologies necessary to manufacture biological weapons, devastating effects are placed upon a military, an economy, and the environment. Proliferating states only need a starter culture of an agent to begin an offensive biological weapons program. WMD, along with the delivery systems, creates an enormous risk for the member states and their forces and constitutes a threat to international security. To provide the member states a stable security environment, NATO will have to confront this dreadful challenge head on.

Despite major efforts in reducing nuclear and chemical capable threats throughout the world, biological weapons require the same amount of attention if not more from the Alliance. Nuclear and chemical weapons seem to receive most of the attention with publications while biological weapons are just "mentioned" concerns. The intelligence communities

within the Alliance have definitely underestimated the biological programs of other states and adversaries. Two primary examples include the miscalculated Iraqi biological weapons programs and the Russian Biopreparat program.

Biological technologies have legitimate military or civilian applications separate from WMD. As these dual use technologies spread throughout the world, the probability of biological terrorism will only increase. Since biological weapons do not require infrastructures as costly as those necessary to manufacture and maintain nuclear or even chemical weapons, they become very attractive to other states, terrorist groups, or even religious cults. A recent example involves the Aum Shinrikyo Cult. In March 1995, the attack on the Tokyo subway station by the Japanese cult proved that WMD have extended the "battlefield" to the civilian sector. This particular group has links with 10,000 members in Japan and 20,000 members in Russia and North Korea.[1] Both Russia and North Korea are suspected nations of developing offensive biological weapons. It has also been reported that the Aum Shinrikyo cult has attempted to obtain the Ebola virus as well as aircraft and drones as

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[1]Douglas Jr., Joseph D. "Chemical and Biological Warfare Unmasked", Wall Street Journal. November 2, 1995.

the delivery systems.[2] An incident like this one represents a new dimension of terrorism and complicates the problem with the proliferation of such terrifying weapons. Nations have a hard enough time trying to control the increasing cases of infectious diseases that have recently resurfaced: TB, Meningitis, Cholera, and Ebola.

Challenging the proliferation of WMD requires enormous attention from the Alliance, especially pertaining to biological weapons. Many NATO platforms and forces could easily be targeted or attacked with WMD during any peacetime or wartime operations. The major concerns for the Alliance are the increasing possibilities that surrounding states, including the non-state actors, are trying to acquire or develop WMD, the increasing worldwide trade of WMD systems, and the increasing "human capital" investments for technical expertise.[3]

When the Biological Weapons Convention was opened for signature in 1972, four countries were suspected of

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[2]Douglas Jr., Joseph D. "Chemical and Biological Warfare Unmasked", Wall Street Journal. November 2, 1995.

[3]"Human capital" investment refers to a national investment in education in order to increase the productivity of biological weapons. This includes sending students to other countries, such as the United States, to study the biological sciences and genetic engineering or acquiring highly trained graduates in the sciences from leading universities.

developing offensive biological weapons.[4] In 1992, there were ten such countries.[5] Now, there are approximately 12 suspected countries actively involved in the development of offensive biological weapons.[6] Some of these countries are also members of the Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction (BTWC). Russia, a member of the BTWC and the Partnership for Peace program, is one of two countries, the other being the United States, that is directed by the United Nations Health Agency to eradicate the remaining stocks of smallpox by June 30, 1999.[7] Will the Russians try to smuggle smallpox samples out of their country or will they act as directed?

NATO's current policies regarding WMD do not highlight the increasing threat of biological weapons. NATO must recognize changes of the environment in order to offer new ideas, enforce their views against the proliferation of

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[4]GAO Report. Arms Control: U.S. and International Efforts to Ban Biological Weapons. (Washington, D.C.: United States General Accounting Office, December 1992), 16.

[5]GAO Report. Arms Control: U.S. and International Efforts to Ban Biological Weapons. (Washington, D.C.: United States General Accounting Office, December 1992), 16.

[6]Tucker, Jonathan B. "Strengthening the Biological Weapons Convention", Arms Control Today. Vol. 25, No. 3. (Washington, D.C.: Arms Control Association, April 1995), 9.

[7]Associated Press. "Health Agency Agrees to Eradicate Smallpox", Monterey Co. Herald. May 25, 1996.

biological weapons within the NATO publications, and take the lead in strengthening the BTWC. NATO's strategic concept provides guidance for its members and their forces. Nuclear and chemical weapons have had the spotlight in recent policies. Now, NATO must enlarge concepts pertaining to biological weapons. Will it take an offensive employment of a biological agent to include biological weapons in important documents? Or will it take mass casualties from a biological attack? There are many challenges facing NATO regarding the employment of biological weapons to include the threat of proliferation of WMD and advanced conventional weapons to deter the employment of biological weapons. NATO must establish a proactive stand against the proliferation of such weapons. Preventing the proliferation of WMD must remain a primary goal for NATO, but biological weapons have to be specifically highlighted as well.

Current intelligence assets and non-proliferation regimes are mainly focused on nuclear and chemical weapons proliferation. NATO must publicly highlight views concerning biological warfare in order to educate the community on biological weapons issues, deter the employment of biological weapons, and increase a sense of security within the Alliance. Biological warfare issues create policy and security concerns on a global scale. When

policies indicate a higher concern towards biological weapons, intelligence agencies will increase their efforts in this particular area as well.

This thesis will prove that NATO members must refocus their policy efforts regarding biological warfare. NATO, a central distribution point of a multinational organization, has the opportunity to educate the world in the challenge against biological warfare. To accomplish this task, the thesis will: (1) examine current NATO policies and explore the challenges NATO will encounter regarding WMD, (2) examine the potential threats of biological agents, (3) explore the possibility of terrorist or religious organizations that may employ biological weapons in support of their activities, and (4) determine the implications and analysis of biological warfare to the intelligence community to include an unclassified data base of biological events which can provide indications and warnings of future biological weapon events.

Biological weapons are an increasing threat to world security. These weapons of mass destruction can have devastating effects on military and civilian communities as well as the environment. If a nation or terrorist group has the knowledge to produce the agent, the facility to develop the agent, and the delivery system to transfer the agent,

then that nation or terrorist group has the ability and capability to produce biological weapons. When a nation or terrorist group illustrates the willingness and capability to use biological weapons, then that nation or terrorist group is a world security threat. Intelligence exists because of policies set forth by our government and foreign governments. If policies change, then intelligence organizations will refocus their efforts towards the new areas of concern. NATO can set the example and lead the fight against biological warfare.

II. NATO's POLICIES TOWARD BIOLOGICAL WARFARE

Although the Alliance faces significant international changes, the purpose of maintaining the security and peace of its members must remain intact. With the end of the Cold War, the Alliance encounters numerous challenges, especially from the rising proliferation of WMD and the specific knowledge of producing them. According to Article 5 of the Washington Treaty, NATO has a vital responsibility to "deter and defend against any threat of aggression against the territory of a NATO member state".[8] WMD, along with the delivery systems, create an enormous risk for the member states and their forces and constitute a threat to international security. Nations and various other groups with WMD can easily generate political or humanitarian disasters. As President Clinton stated in his speech to the United Nations on September 27, 1993:

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[8]Schulte, Gregory L. "Responding to Proliferation: NATO's Role", NATO Review. July 1995. p. 15.

> For, as we all know so painfully, the end of the Cold War did not bring us to the millennium of peace. Indeed, it simply removed the lid from many cauldrons of ethnic, religious, and territorial animosity...Thus, as we marvel at this era's promise of new peace, we must also recognize that serious threats remain...As WMD fall into more hands, even small conflicts can threaten to take on murderous proportions.[9]

The world is now more complicated, less predictable, and more dangerous than the days of the Cold War. The Alliance must magnify all efforts against the proliferation of WMD and their means of delivery. To provide the member states a stable security environment in Europe and North America, NATO will have to face this horrifying challenge.

A. CURRENT POLICIES REGARDING THE BIOLOGICAL WARFARE THREAT

To challenge the proliferation of WMD while preserving a sense of security for the Alliance, NATO has developed three policies: (1) Alliance's New Strategic Concept, (2) Alliance's Policy Framework on Proliferation of Weapons of Mass Destruction, and (3) NATO's Response to Proliferation of Weapons of Mass Destruction. Although these policies address the proliferation of WMD, they only highlight nuclear and chemical weapons as the primary elements of international stability and cooperative security.

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[9]Clinton cited in Pearson, Graham S. "Forging An Effective Biological Weapons Regime", Arms Control Today. Vol. 24, No. 5. (Washington, D.C.: Arms Control Association, June 1994), 14.

Biological weapons seem to be hidden within the WMD phrase. Since WMD includes nuclear, chemical, and biological weapons, biological weapons cannot be viewed as "mentioned" concerns. The threat of biological weapons is increasing. NATO's policies must expand concepts pertaining to biological weapons to reflect the current changes in the proliferation arena.

> The Chinese have a saying that 'change is a dragon.' There are ways to respond to that dragon. You can ignore him and hope he goes away, but no matter how many times you tell yourself that he is not there or how much you wish he would leave, the dragon that is change remains. If you continue to ignore him, he will eat you. You can try to control the dragon of change, try to force him into a path of your choosing. Push him and pull him. But the dragon is powerful and will not go where you want him to go. He will ultimately knock you down and eat you. But if you ride the dragon of change, you can avoid his lethal powers. You can survive; you can even prosper. Accept change; constantly anticipate and adapt to it; and always take advantage of the opportunities it brings. This is the strategy we must embrace.[10]

NATO represents more than a central distribution point for the development of policies that preserve the sense of security of the Alliance. NATO's policies extend well beyond the Alliance's boundaries. The changing environment offers new opportunities for the Alliance. The threats of biological warfare require the same amount of attention that

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[10]General Charles C. Krulak, Commandant of the United States Marine Corps, cited in Sparling, Steven C. "Riding the Dragon of Change", Surface Warfare. Vol. 21, No. 4. (United States: Harmony Printing & Development Company, July/August 1996), 4.

nuclear and chemical warfare receives within NATO policies.

The *Alliance's New Strategic Concept* takes a broad approach to security based on three concepts: (1) dialogue through regular diplomatic liaison, (2) cooperation with all members regarding pertinent fields of security, and (3) collective defense through the preservation of appropriate military capabilities. It illustrates the concern for reducing the dependence on nuclear weapons, increasing the integration of multinational military forces, controlling conventional forces, and banning against chemical weapons. The policy portrays the functions of the Alliance and validates the significance of the Alliance within the changing environment.

The major problem with the *Alliance's New Strategic Concept* is that it does not include the threat of biological weapons. WMD within the *Alliance's New Strategic Concept* seem to involve only nuclear and chemical weapons. Not once does this particular document mention biological weapons. It only "hides" this type of warfare within the WMD phrase. This is totally unsatisfactory, especially when the document clearly separates nuclear and chemical warfare. Will it take an offensive employment of a biological agent to include biological weapons in important documents such as this one? Or will it take mass casualties from a biological

attack? These questions might be simplistic in nature, but NATO must establish a proactive stand against the proliferation of such weapons. Preventing the proliferation of WMD must remain a primary goal for NATO, but biological weapons have to be specifically highlighted as well and not just taken for granted.

Knowing the threat of WMD creates a sense of instability in international security, the Alliance has established a *Policy Framework on Proliferation of Weapons of Mass Destruction* and *NATO's Response to Proliferation of WMD*. These policies recognize that the proliferation of WMD is an international security threat, acknowledge the fact that other nations are striving to acquire the technologies to produce WMD, and realize that the Alliance must increase political and defensive efforts against the proliferation of WMD. The major problem with the *Policy Framework on Proliferation of Weapons of Mass Destruction* and the *NATO's Response to Proliferation of WMD* is that they seem to focus upon the proliferation of ballistic type weapons as delivery systems. Ballistic weapons are not the only delivery systems for biological agents. Biological agents can be delivered by various aerosol sprayers, artillery, and aircraft. This policy cannot focus upon one type of delivery system. There are many other delivery systems

nations can use towards the employment of biological weapons.

Politically, the goal is to "prevent proliferation from occurring or, should it occur, to reverse it through diplomatic means".[11] This means regular consultations on WMD and sharing of information between all countries associated with the Alliance. Dialogue will - it is hoped - establish a sense of obligation needed to fight against the proliferation of WMD. Biological weapons create problems with verification, but with regular consultations and information sharing, the Alliance will come closer to verification capabilities leading to a more comprehensive and affective non proliferation effort.

The problem with the political dimension of the Alliance is that not all members voluntarily share information.[12] All members of NATO must share information on their various advances in the biological arena in order to pursue the necessary knowledge of biological warfare and to support the safe and secure dismantlement of biological weapon facilities. Since there are members of the Alliance

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[11]NATO Press Release, "Alliance Policy Framework on Proliferation of Weapons of Mass Destruction". (Brussels: NATO Press Service, June 9, 1994), 3-4.

[12]Statement is based upon Dr. Marcel Leroy's lecture, "European Security and Defense Identity: NATO, the WEU, and the European Union", on January 24, 1996 at the Naval Postgraduate School. Dr. Leroy has been the Head, Multilateral and Regional Affairs Political Affairs Division, NATO Headquarters: Brussels, Belgium since January 1991.

that do not have the political fortitude to share this valuable biological information, the Alliance should make it a mandatory action. If members withhold information, those members should be "politically embarrassed". To challenge the dreadful threat of biological warfare, all members of the Alliance must make a major effort. Exchanges of all types of information elevates the educational awareness for the entire organization. When the Alliance collectively contributes information towards biological warfare, a commonality of thinking towards biological warfare will be created. A lackadaisical effort towards biological warfare will haunt every member of the Alliance, not just the members who do not offer information.

Although all NATO members have signed and ratified the BTWC, not all of the Partnership for Peace (pfp) members are listed as countries who have signed and ratified this particular document.[13] The seven countries not listed include: Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, and Moldova.[14] The Partnership for Peace program was created to increase the confidence and cooperation efforts to reinforce security, build concrete

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[13]See Appendix A for a copy of the BTWC.

[14]These countries are not listed within the U.S. Arms Control and Disarmament Agency's Chemical and Biological Weapons Reader Fact Sheet. March 1996.

cooperation activities designed to achieve objectives, and strengthen relations with NATO.[15] This cannot be achieved if there are members of the pfp who have not signed and ratified the BTWC.

If the aforementioned countries wish to become NATO "partners", they should also sign and ratify the BTWC for the support of non-proliferation of such WMD and for world security. Countries with previous ties with the Soviet Union might have had extensive biological warfare experience. Inspections of these countries or assessments of the their biological weapons knowledge could improve current policies.

Defensively, NATO seeks military capabilities to deter the use or proliferation of WMD and defend the Alliance's territory and forces. A problem with NATO's defensive measure is that it needs more emphasis on protecting the troops from a biological attack. This includes protective equipment, detection devices, decontamination procedures, and biological warfare training.

> Weapons of mass destruction - nuclear, biological, and chemical - along with their associated delivery systems, pose a major threat to our security and that of our allies and other friendly nations. Thus, a key part of our strategy is to seek to stem the proliferation of such weapons and to develop an effective capability to deal

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[15]NATO Handbook. (Brussels: NATO Office of Information and Press, 1995), 50.

with these threats.[16]

Improving these capabilities, from a collective aspect, will increase the understanding of biological warfare and establish a more protective environment for the troops against a biological threat.

Similar to NATO's policies towards biological warfare, the defensive measures focus upon the maintenance of nuclear and conventional warfare. Higher priorities need to be associated with biological warfare. Since the threat of biological warfare is not highlighted within NATO's policies, NATO's leaders and military commanders will not place adequate biological warfare training for the troops.

The Persian Gulf War clearly illustrates the inadequate defenses, lack of training, and medical imperfections towards a biological attack within the first six months of the conflict.[17] These troops were highly susceptible to any biological attack from the Iraqi troops. These insufficient defenses against biological attacks during the Persian Gulf War were results of an "inconsistent and lower priority"

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[16]The White House was cited in A National Security Strategy of Engagement and Enlargement. (Washington, D.C.: White House Press, February 1995), 13.

[17]GAO Report. Chemical and Biological Defense: Emphasis Remains Insufficient to Resolve Continuing Problems. (Washington, D.C.: United States General Accounting Office, March 12, 1996), 1.

assignments towards biological defenses.[18] The troops are extensions of NATO policies. The leaders of the Alliance cannot afford to allow biological warfare take the lives of military personnel who are providing the security and freedom for other members of NATO.

Major efforts to reduce nuclear and chemical threats throughout the world have been undertaken. Jointly pursued political and defensive measures will heighten awareness of the need to take action against the proliferation of WMD. Biological weapons require the same amount of attention, if not more, from the Alliance. NATO cannot afford to be complacent with the increasing threat of biological weapons. The use of biological weapons dates back to over two thousand years ago when contaminated bodies were used against their adversaries.[19] If certain countries express a willingness to incorporate biological weapons in their military operations, NATO's defensive military operations may be directly affected. NATO must be able to protect its forces and destroy biological facilities to defend against any biological attacks. The number of countries capable of

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[18]GAO Report. Chemical and Biological Defense: Emphasis Remains Insufficient to Resolve Continuing Problems. (Washington, D.C.: United States General Accounting Office, March 12, 1996), 1.

[19]Kupperman, Robert H. And David M. Smith. "Coping With Biological Terrorism", Biological Weapons: Weapons of the Future ? Vol. 15, No. 1. (Washington, D.C.: The Center For Strategic and International Studies, 1993), 37.

using biological weapons is increasing. When nations signed the BTWC in 1972, there were only four countries with biological weapons programs.[20] In 1992, there were ten countries.[21] Now, there at least 12 countries suspected of having offensive biological weapons programs.[22] NATO must install the realistic threat of biological weapons to the members of the Alliance in order to refocus intelligence efforts towards biological warfare.

B. CHALLENGES FACING NATO

1. Deterrence of Biological Weapons

The deterrence of biological weapons use creates a problem for the Alliance. To deter another nation from using such weapons, the defending nation must establish the capability and the willingness to utilize its own weapon systems against the enemy forces. The defending nation must develop and use highly effective defensive or offensive weapon systems that would make biological weapons ineffective. Some possible deterrent strategies include: (1) threatening to use biological weapons to deter the

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[20]GAO Report. Arms Control: U.S. and International Efforts to Ban Biological Weapons. (Washington, D.C.: United States General Accounting Office, December 1992), 16.

[21]Ibid.

[22]Tucker, Jonathan B. "Strengthening the Biological Weapons Convention", Arms Control Today. Vol. 25, No. 3. (Washington, D.C.: Arms Control Association, April 1995), 9.

employment of biological weapons, (2) threatening to use advanced conventional weapons to deter the employment of biological weapons, (3) threatening with a large scale conventional attack to deter the employment of biological weapons, and (4) threatening to use nuclear weapons to deter the employment of biological weapons. Neighboring states of the Alliance could use deterrence strategies not supported by the Alliance.

Prior to 1972 when President Nixon decided to abolish all U.S. biological and toxin weapons, the United States developed biological agents to deter the employment of biological agents by other countries.[23] Although the United States eliminated all biological and toxin weapons from its arsenals, other nations will continue to develop biological weapons. Since nations have noticed the difficulties of accurately pinpointing violations of the BTWC, the biological weapon is a perfect weapon for those who have or have not signed and ratified the BTWC. Although potential hazards associated with biological weapons exist, technological advances in biological warfare are increasing which enable other countries to "maximize storability,

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[23]Bailey, Kathleen. "Deterrence of Biological Weapons", Draft. (California: Lawrence Livermore National Laboratory, September 6, 1995), 1.

lethality, and survivability" of biological agents.[24]

Another method of deterrence is increasing the amount of conventional weapons. If countries can produce and threaten with a substantial amount of advanced conventional weapons, they might be able to deter others from employing biological weapons.[25] Extensive manpower capabilities with advanced conventional weapons could present an overwhelming picture towards the enemy with biological weapons. Although the increase of advanced conventional weapon systems is a costly investment and could place more lives in danger, this is an option for countries that do not want to take chances with biological agents, especially countries that have signed and ratified the BTWC. But other nations might not be able to afford large amounts of troops or do not have the technological expertise required for such weapon systems which results in possibly choosing another weapon: the biological weapon.

Establishing a threat with a nuclear capability to deter the employment of biological weapons is a costly investment, but has proven to be very effective - at least

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[24]Bailey, Kathleen. "Deterrence of Biological Weapons", Draft. (California: Lawrence Livermore National Laboratory, September 6, 1995), 1.

[25]Ibid. p. 2.

in some cases.[26] The Persian Gulf War is a perfect example. Iraq admitted to preparing biological weapons for employment against U.S. and coalition forces, but decided not to use these weapons for "fear of U.S. nuclear retaliation".[27] One of NATO's defensive measures involves maintaining minimum levels of nuclear weapons to "preserve peace and prevent war or any kind of coersion".[28] This defensive measure only encourages other nations to establish nuclear capabilities. To deter biological weapon attacks while avoiding any violations of the BTWC, nations could decide to invest in nuclear weapons.

Proliferation of nuclear weapons to deter the employment of biological weapons has downfalls. First, proliferation of nuclear weapons causes a weakening of the Nuclear Non-Proliferation Treaty (NPT). From fear of increasing biological weapon capabilities, countries currently without nuclear weapons may not want to rely on the security commitments of the Alliance and may want to initiate their own nuclear weapon capabilities for the sake of defending themselves. Future scenarios could easily

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[26]Bailey, Kathleen. "Deterrence of Biological Weapons", Draft. (California: Lawrence Livermore National Laboratory, September 6, 1995), 2.

[27]Arms Control Today. "Iraq Provides IAEA With Significant New Information". Vol. 25, No. 7. (Washington, D.C.: Arms Control Association, September 1995), 27.

[28]NATO Handbook. (Brussels: NATO Office of Information and Press, 1995), 41-42.

involve executive decisions on utilizing nuclear weapons against nations without nuclear weapons which would initiate strong opposing views. Second, the proliferation of nuclear weapons could also cause an increase demand for nuclear weapons with smaller yield ratios. For example, the U.S. arsenal is comprised mostly of weapons with yields of 5KT designed for massive destruction of the former Soviet Union.[29] These weapons are not necessary against smaller nations.

Deterrence is a complex subject that every nation must face. With the threat of biological weapons, nations will develop weapon systems to protect themselves. The non-state actors, on the other hand, do not sign or ratify treaties so they will acquire whatever means possible to protect their interests.

2. Strengthening the BTWC

Nations have supported the BTWC based upon three assumptions: (1) biological weapons were not perceived to be a viable weapon option, (2) production of large quantities in a relatively short time was assumed to be technologically difficult and beyond the capabilities of many states, and (3) developed states that could produce such weapons already

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[29]Bailey, Kathleen. "Deterrence of Biological Weapons", Draft. (California: Lawrence Livermore National Laboratory, September 6, 1995), 5.

have access to nuclear systems to deter the nuclear, chemical, and biological threats.[30] The world changes constantly and these past assumptions are no longer valid. Iraq as well as non-state actors, such as the Japanese Aum Shinrikyo cult, view biological weapons as viable weapons. Some nations seek a biological weapon capability as a strategic WMD - "poor man's atomic bomb" and as an equalizer against major powers like the United States.[31] Non-state actors are acquiring the technological requirements for biological capabilites. And the increasing biological weapons threat could encourage nations to develop other than nuclear weapons systems to deter the employment of biological weapons. The increasing advances in the biological sciences and the potential applications for these advantages illustrate the need to strengthen the BTWC to reflect current scenarios. NATO must commit themselves in strengthening the BTWC as a critical element of the global non-proliferation regime covering nuclear, chemical, and biological weapons.

The changed environment offers new opportunities for

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[30]Latter, Dr. Richard. "The Increased Danger of Biological Weapons Proliferation", Jane's Intelligence Review. (United Kingdom: Huntcard Litho, February 1994), 93.

[31]Tucker, Jonathan B. "Strengthening the Biological Weapons Convention", Arms Control Today. Vol. 25, No. 3. (Washington, D.C.: Arms Control Association, April 1995), 9-10.

NATO to strengthen the BTWC. There are nine areas that can assist nations in improving the BTWC:

(a) With new technological advances in biological sciences, nations must reaffirm that the creation of biological agents or toxins, by any means, for weapons is not justified under the BTWC for military purposes or protection from possible enemy employment of biological agents. Nations must have a definition on the amounts of biological agents allowed for "prophylatic, protective, or other peaceful purposes".

(b) As nations destroy biological weapon facilities or shift to peaceful purposes, nations should conduct these processes through a standardized list of actions which is constantly reviewed after each case in order to provide the necessary protection of the local population and environment. This will also encourage nations to work more closely in the biological field.

(c) All members of the BTWC need to enforce domestic legislation making it a crime for their citizens to develop, produce, stockpile, or acquire biological or toxin agents or weapons. This could deter non-state actors from acquiring biological agents or weapons.

(d) Nations should submit a semi-annual report that includes updates of all domestic facilities (government, commercial, or private) as well as inputs from experts on strengthening measures for the BTWC.

(e) If nations have questions concerning a particular facility or program, then these nations should have the right to inquire about the facilities or programs.

(f) Nations should give advanced notice on military training exercises in biologicial warfare defenses. This would encourage joint operations in preparations for possible threats to military forces.

(g) Routine inspection team training exercises must be conducted in order to influence improvements in inspection techniques. This would also enhance research in developing improved detection devices for small quantities of agents.

(h) In order to assist inspection teams, all facilities must be required to keep updated records (names,

organizational charts, medical records, accident reports, project reports, and lessons learned reports). Not only will this assist the inspection teams, but it could also improve the organization of other facilities.

(i) All nations must monitor human capital investments. Only a small number of knowledgeable people are needed to produce biological agents for weapons. Iraq claims its programs only consisted of ten people.[32]

Although these measures can present problems with the pharmaceutical or bio-technology industries, biological agents and their potential users or applications is a very serious matter which should not be taken lightly. Biological weapons could be used by countries or terrorist groups against NATO civilian or military personnel as well as installations to deter NATO force involvement in a particular state affair or even to increase a status quo.

Cases like the outbreak of anthrax in Sverdlovsk and the Russian Biopreparat program create a concern about the effectiveness of the BTWC. Strengthening the BTWC must be a high priority for the members of NATO. The attractiveness of such weapons will only increase if NATO does not take an active role. Instituting sanctions against those countries who do not report "high contaminated biological facilities" or "unusual outbreaks" will increase participation. International sharing of information or intelligence

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[32]Bailey, Kathleen. "Responding to the Threat of Biological Weapons", Security Dialogue. Vol. 26. (Livermore, California: Sage Publications, 1995), 386.

gathering methods could improve measures against the threat of biological warfare. The practice of utilizing all available information and methods in creating the final intelligence product will increase the likelihood of successful inspections. The unveiling of the Biopreparat program is an example.[33]

Dealing with the proliferation of WMD requires enormous attention from the Alliance, especially pertaining to biological weapons. Many NATO platforms, forces, bases, ports, and cities could easily be targeted and attacked with WMD during any peacetime or wartime operations. The Alliance must take steps to diminish the advantages that biological weapons offer its adversaries. The increasing possibilities that surrounding states and non-state actors are trying to acquire or develop WMD, the increasing worldwide trade in WMD systems, and the increasing "human capital" investments for WMD technical expertise (notably in the former Soviet Union) remain major concerns for the Alliance.

To improve NATO's protective capabilities, the Alliance must to proactive. NATO cannot afford to let threats of biological warfare weaken the sense of security among its members. NATO must enforce and exemplify a strong

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[33]The Russian Biopreparat program will be discussed in Chapter V.

commitment to security so that it weakens any threat of biological warfare. This could be done by improving intelligence gathering techniques, examining biological security matters frequently in publications, and strengthening the BTWC.

NATO must take the lead to strengthen the BTWC and enforce its views against the proliferation of biological weapons within the *Alliance's New Strategic Concept* and other NATO policies such as *Alliance's Policy Framework on Proliferation of Weapons of Mass Destruction and NATO's Response to Proliferation of Weapons of Mass Destruction*. This can only increase the sense of security and confidence needed when tackling this complex issue. The *Alliance's New Strategic Concept* provides guidance for the forces and the member states. Nuclear and chemical weapons have the spotlight. Now the spotlight needs to be directed towards biological weapons.

III. BIOLOGICAL AGENTS AS WARFARE THREATS

One reason why NATO should magnify all efforts against the proliferation of biological weapons and their means of delivery is the potential hazards of biological agents. Although most researchers study biological agents for medical or peaceful purposes, some researchers develop biological agents or use existing biological agents for the purpose of creating biological warfare programs.[34] Nations or non-state actors with the knowledge of biological agents, the equipment to produce biological agents, biological agents themselves, and the delivery systems to transport biological agents to a desired location are threats to the international security. These agents cannot be viewed as just military threats. Biological agents have the potential to cause military, political, economic, and environmental insecurities throughout the world.

As biotechnology advances, the threat of biological warfare increases. Normal microorganisms are now being modified for the purposes of biological warfare. Worldwide outbreaks could actually be a biological attack or biological test site. Improvements in biotechnology and the

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[34]The definition of biological warfare is the use of living organisms or by-products of organisms to cause death or incapacitation in man, animals, or plants for military, terrorist, economic, or environmental purposes.

dual use nature of these agents and related equipment will encourage some nations or groups to initiate biological programs and risk any violations of the BTWC. Since the research of biological agents can be masqueraded as defensive programs and the ability to identify an offensive biological warfare program is extremely difficult, illicit activities will only increase.

George W. Merck, special consultant for biological warfare, once stated:

> The development of agents for biological warfare is possible in many countries, large and small, without vast expenditures of money or the construction of huge production facilities. It is clear that the development of biological warfare could very well proceed in many countries, perhaps under the guise of legitimate medical or bacteriological research.[35]

The breakup of the former Soviet Union could have easily released a large amount of technical and educational abilities on the world market. Resources for biological programs are available. Nations or non-state actors choose biological weapons for the following reasons:

(a) The need to deter the employment of other weapons systems, influence political or military aspects of potential enemies, or develop a status quo;

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[35]George W. Merck cited in Geissler, Erhard. Biological and Toxin Weapons Today. (Stockhom International Peace Research Institute: Oxford University Press, 1986), 1-2. G.W. Merck also headed the War Research Service in the 1940's.

(b) Potential biological warfare agents are domestically or internationally available from manufacturers or natural resources;

(c) Sophisticated R&D programs are unnecessary to develop biological agents for weapon purposes;

(d) Information on producing biological agents and required personnel for developing these agents are available worldwide;

(e) Small scale facilities are capable of producing large quantities of biological agents;

(f) It is relatively cheap to develop a biological warfare program;

(g) The delay of symptoms causes difficulties to identify the exact time and location of an initial attack;

(h) Biological agents have the capabilities to produce large amounts of causualties in a relatively short period of time with minimal material damage; and

(i) Detection devices are unreliable.

NATO must directly deal with the threat of biological weapons. Pentagon officials from the United States claim that "people inside and outside the Pentagon look away and say 'it's too hard, too horrible' to deal with the threat of biological weapons...We're not doing enough."[36] Since biological agents have the potential to become a biological weapon threat, they should not be taken lightly. NATO must make the necessary policy adjustments to address the changing environment.

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[36]Weiner, Tim. "Weapons of Mass Destruction Are Spreading, Pentagon Warns", New York Times. April 12, 1996.

A. BIOLOGICAL AGENTS AND CAPABILITIES

Biological warfare agents can have strategic or tactical missions.[37] They can be employed for the purpose of incapacitating the enemy with a disease or causing a large quantity of deaths with another disease. These agents have the capability to be tremendous hazards to every nation. Lethal dosages of biological agents only range from 10^{-3} to 10^{-8} mg per person and toxins range from 1 to 10^{-4} mg per person.[38] These are much smaller amounts when compared to chemical agents. Nations must realize the lethality of these agents in their natural state. Once these agents fall

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[37]Types of biological warfare agents include: Bacteria: single cell organisms that are the causative agents of anthrax, brucellosis, tularemia, plague, and numerous other diseases. They vary considerably in infectivity and lethality. They are present within air, water, animals, plants, living or dead. Rickettsiae: microorganisms that resemble bacteria in form and structure but differ in that they are intracellular parasites that can reproduce inside animal cells, especially in fertilized chicken eggs. Examples of rickettsia diseases for biological warfare include typhus, Rocky Mountain spotted fever, and Q fever. Virus: intracellular parasites that are approximately 100 times smaller than bacteria. They can infect humans, crops, or domestic animals. A virus's strength can be altered to increase efficiency. A particularly powerful strain of an endemic pathogen could simply be blamed on a natural mutation. An example of a virus for biological warfare is Venezuelan Equine Encephalitis. Fungi: devastating to plants and might be used to destroy staple crops and cause widespread environmental and economic hardships. Examples include rice blast, corn smut, cereal and wheat rust, and potato blight. Toxin: poisonous substance made by a living system, or a synthetic analogue of a naturally occurring poison. An large variety of toxins are manufactured from bacteria, fungi, marine organisms, plants, insects, spiders, and other animals. This information was cited in The Chemical and Biological Weapons Threat. (Washington D.C.: Nonproliferation Center, March 1996), 16-17.

[38]U.S. Congress, Office of Technology Assessment, Technologies Underlying Weapons of Mass Destruction, OTA-BP-ISC-115 (Washington, D.C.: U.S. Government Printing Office, December 1993), 77. One paper clip weighs approximately 500 mg.

into more "unfriendly" hands, the world could be in grave danger.

Infectious diseases, caused by biological agents, throughout the world are steadily increasing and killing more people than in the past.[39] These diseases are actually defending themselves against previously used antibiotics and have become the third leading killer in the United States.[40] In the United States, the death rate from infectious diseases rose 58% between 1980 to 1992 and without AIDS, the death rate rose 22%.[41] Cases of cholera, tuberculosis, diphtheria, and bubonic plague have all increased in the last five years.[42] According to Joshua Lederberg, "The world is more vulnerable than ever before".[43] Worldwide medicine is fighting with the rise of infectious diseases and the biological agents seem to be winning. As nations or non-state actors observe the increasing problems created by

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[39]Associated Press. "Doctors Tell of International Resurgence in a Variety of Infectious Diseases", New York Times. January 17, 1996.

[40]Ibid.

[41]Hanley, Charles J. "Infectious Diseases Making Comeback", Monterey County Herald Tribune. May 5, 1996.

[42]Howe, Peter J. "Infectious Disease Rate Soars in U.S.", Monterey County Herald Tribune. January 8, 1996.

[43]Joshua Lederberg cited in "Doctors Tell of International Resurgence in a Variety of Infectious Diseases", New York Times. January 17, 1996. Dr. Lederberg is a geneticist, Nobel laureate, and president emeritus of Rockefeller University.

the biological agents, they will realize that biological agents are proving to be an outstanding weapon of choice. Major emphasis must be placed upon the emerging problems before they become worldwide crisis.

Appendix B illustrates a history of biological events that the world has encountered.[44] In the current decade, the world has faced Yellow Fever, Hantaan Virus, Cryptosporidios, Machupo Virus, Ebola Virus (Zaire & Reston), Meningitis, Cyclospora, and O157:H7 outbreaks. These outbreaks have caused millions of deaths and sicknesses, psychological problems, loss of millions of dollars, closings of athletic events, shortening of vacation and pilgrimage trips, and even closings of schools. Policies have to highlight biological agents as warfare issues before biological agents conquer the world.

Table 1 illustrates the list of organisms with potential biological warfare applications. The highlighted areas of this particular table indicate the organisms that have surfaced since 1970. Eight of these organisms have resurfaced within the current decade. Table 2 illustrates animal pathogens with potential biological warfare

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[44]The historical biological data base is an unclassified document illustrating the date of the event, a short description of the event, the biological agent involved, whether the event was a military, environmental, or terrorist event, and additional remarks to include the number of deaths involved in the event.

applications. The highlighted pathogen in Table 2 resurfaced in a terrorist situation in 1984. Table 3 illustrates a warning list of other organisms with potential biological warfare applications. The highlighted areas of Table 3 indicate the organisms that have surfaced since 1961. Two of these organisms have resurfaced within the current decade. The world needs to wake up and seriously challenge this issue of biological agent threats before more innocent people and animals are killed or incapacitated.

Table 1: List of Organisms with Potential Biological Warfare Applications

VIRUSES	*RICKETTSIAE*	*BACTERIA*	*TOXINS*
Chikungunya Virus	Coxiella Burnetii	Bacillus Anthracis	Botulinum Toxins
Congo-Crimean Haemorrhagic Fever Virus	Rickettsia Quintana	Brucella Abortus	Clostridium Perfringens Toxins
Dengue Fever Virus	Rickettsia Prowasecki	Brucella Melitensis	Conotoxin
Eastern Equine Encephalitis Virus	Rickettsia Rickettsii	Brucella Suis	Ricin
Ebola Virus		Chlamydia Psittaci	Saxitoxin
Hantaan Virus		Clostridium Botulinum	Shiga Toxin
Junin Virus		Francisella Tularensis	Staphylococcus Aureus Toxins
Lassa Fever Virus		Pseudomonas Mallei	Tetrodotoxin
Lymphocytic Choriomeningitis Virus		Pseudomonas Pseudomallei	Verotoxin
Machupo Virus		Salmonella Typhi	Microcystin (Cyanginosin)
Marburg Virus		Shigella Dysenteriae	
Monkey Pox Virus		Vibrio Cholerae	
Rift Valley Fever Virus		Yersinia Pestis	
Tick-Borne Encephalitis Virus (Russian Spring-Summer Encephalitis Virus			
Variola Virus			
Venequelan Equine Encephalitis Virus			
White Pox			
Yellow Fever Virus			
Japanese Encephalitis Virus			

Source: The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government, 1995), 33.

Table 2: Animal Pathogens with Potential Biological Warfare Applications

VIRUSES	*BACTERIA*
African Swine Fever Virus	Mycoplasma Mycoides
Avian Influenza Virus (only those of high pathogenicity)	
Bluetongue Virus	
Foot and Mouth Disease Virus	
Goat Pox Virus	
Herpes Virus (Aujeszky's Disease)	
Hog Cholera Virus	
Lyssa Virus	
Newcastle Disease Virus	
Peste des Petits Ruminants Virus	
Porcine Enterovirus (type - 9)	
Rinderpest Virus	
Sheep Pox Virus	
Teschen Disease Virus	
Vesicular Stomatitis Virus	

Source: The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government, 1995), 34.

Table 3: Warning List of Other Organisms

VIRUSES	*BACTERIA*	*TOXINS*
Kyasanur Forest Virus	Clostridium Perfringens	Abrin
Louping Ill Virus	Clostridium Tetani	Cholera Toxin
Murray Valley Encephalitis Virus	Enterohaemorrhagic Escherichia Coli Serotype	Tetanus Toxin
Omsk Haemorrhagic Fever Virus	0157 and other Verotoxin Producing Serotypes	Trichothecene Mycotoxins
Oropouche Virus	Legionella Pneumophila	
Powassan Virus	Yersinia Pseudotuberculosis	
Rocio Virus		
St. Louis Encephalitis Virus		

Source: The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government, 1995), 34.

In the course of history, biological agents have taken more human lives than the actual war or battle itself. Appenix B will clearly illustrate this point. The world is constantly reminded of these biological problems of the past and present through military, economic, and environmental events, but policies still do not reflect the dangers of these devastating "killers".

Biological agents are direct threats to world security. When these agents are employed in military situations, more deaths will occur. As nations or non-state actors develop their biological programs, accidents will occur that will

instantly effect the surrounding environment. When these agents are employed, major problems will occur and the world must be ready for them. This security threat brings new global opportunities. NATO can be the driving factor against the threat of biological agents.

B. DEVELOPING BIOLOGICAL AGENTS & WEAPONS

Biological warfare agents are relatively easy and inexpensive to produce for any nation or non-state actor, especially with pharmaceutical or fermentation capabilities. Since materials for biological agent production are dual use, equipment and technologies for the development of biological agents are available in the commercial market and training can be provided by equipment suppliers or scientific meetings.

Developing biological agent production facilities can be very attractive to nations and non-state actors. Biological warfare facilities, whether declared or undeclared, can be very small structures. Producing biological agents with the capability to kill or incapacitate thousands of people can be manufactured in facilities of 25 m^2 with no distinguishing characteristics.[45]

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[45]Bailey, Kathleen C. "Responding to the Threat of Biological Weapons", Security Dialogue. Vol. 26. (Livermore, California: Sage Publications, 1995), 385.

The required equipment and other materials to produce biological agents would only cost several thousands of dollars and can be manufactured practically by any nation.[46] If nations or non-state actors cannot manufacture these items or find that it is much easier to purchase these items from another country, commercial markets are readily available to provide any assistance.[47] Since this equipment is dual use, these pieces of equipment are also available in medical and research facilities.

Biological agents can be produced with low or high technological techniques. It depends on how much money a nation or non-state actor is willing to provide for the biological program and how discrete they wish to be for the program. Table 4 illustrates key production techniques for biological or toxin warfare agents.

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[46] Bailey, Kathleen C. "Responding to the Threat of Biological Weapons", Security Dialogue. Vol. 26. (Livermore, California: Sage Publications, 1995), 385. Appendix C provides an illustration on producing biological agents by fermentation.

[47] Appendices D, E, and F illustrate over 300 confirmed and unconfirmed worldwide manufacturers of biological related equipment such as fermenters, centrifugal seperators, and freeze dryers to include Australian group countries and non-Australian group countries.

Table 4: Key Production Techniques for BTW Agents

Type of Agent	Low-Tech Production	High-Tech Production
Bacteria	Batch fermentation, production in animals	Genetically engineered strains, continuous flow fermentation
Rickettsiae and Viruses	Cultivation in eggs, mouse brains, or tissue culture (roller bottles)	Culture in mammalian cells grown on beads, microcarriers, or hollow fibers
Protein Toxins	Batch fermentation and purification of a bacterial toxin, or extraction of toxin from a plant or animal source	Cloning of toxin gene in microbial host, extraction
Nonprotein Toxins	Extraction from plant or animal source	Cloning of a series of genes, each governing production of one of the enzymes needed to complete a step in the blosynthetic pathway

Source: U.S. Congress, Office of Technology Assessment, Technologies Underlying Weapons of Mass Destruction, OTA-BP-ISC-115 (Washington, D.C.: U.S. Government Printing Office, December 1993), 91.

Biological warfare agents do not take long to manufacture and large amounts of these agents can be produced in a matter of days.

Although some biological facilities establish the internationally agreed biocontainment levels when producing and handling biological agents, not all facilities follow the protective levels.[48] As nations develop certain biological agents, they may believe that other nations do

[48]There are four internationally agreed biocontainment levels designed for protecting those handling biological agents. Each level represents the number of physical barriers that prevent an organism from escaping to the outside from the handling area. Level four is the highest level of protection. For more information see The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government Printing Office, 1995), 28-29.

not have the proper facilities to handle certain biological agents. Not all nations or non-state actors use these biocontainment levels when developing biological agents. Figure 1 illustrates the four standard biocontainment levels when developing or handling biological agents.

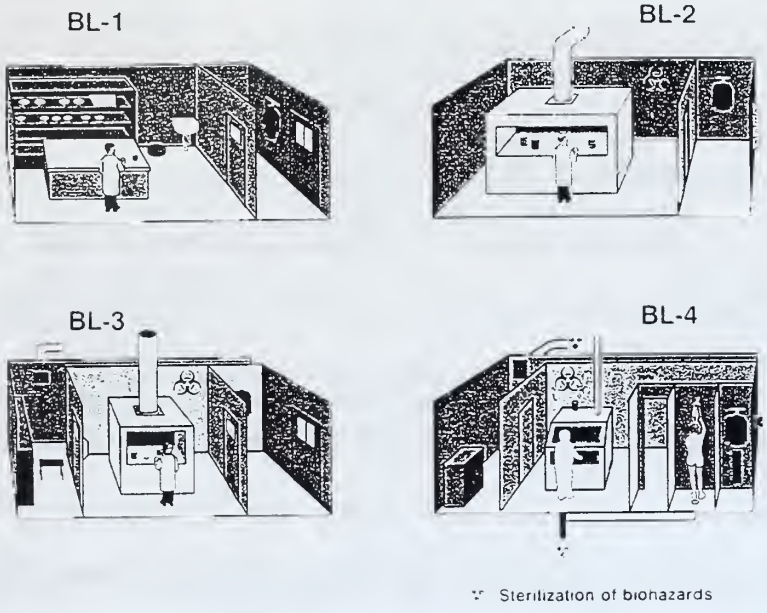

Figure 1: Biocontainment Levels

Source: The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government Printing Office, 1995), 29.

The United Nations inspection teams were surprised after inspectors revealed that crude biocontainment levels, even at the BL2 level, were utilized by Iraqi researchers.[49] NATO cannot underestimate any nation or non-state actor from developing biological weapons. Some nations or non-state

[49]U.S. Congress, Office of Technology Assessment, Technologies Underlying Weapons of Mass Destruction, OTA-BP-ISC-115 (Washington, D.C.: U.S. Government Printing Office, December 1993), 92.

actors might not allow safety precautions delay the development of these weapons.[50]

C. ACCESSIBILITY OF BIOLOGICAL AGENTS

The accessibility of biological agents is not a hard task for nations or non-state actors. "Starter cultures" can be obtained by stealing them from authorized facilities, buying them on the black market or from authorized facilities, receiving them from sponsored groups or nations, extracting them from the natural environment, acquiring samples from outbreak or sickening patients, or even mailing an order to companies that supply organisms for legitimate medical and research facilities. Nations or non-state actors can penetrate these facilities if they really wanted biological agents. The security systems inside U.S. pharmaceutical and bio-technology facilities, for example, are usually not as great as the high level external security of these facilities.[51]

In the past, professional trade journals routinely advertised for the distribution of cultures requiring the company providing the cultures the reason to believe that

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[50]Appendix G illustrates the possible steps in acquiring a military biological or toxin weapon capability.

[51]Bailey, Kathleen C. "Responding to the Threat of Biological Weapons", Security Dialogue. Vol. 26. (Livermore, California: Sage Publications, 1995), 388.

the recipient is properly trained and has the appropriate facilities to handle the biological agents.[52] Now, anthrax cultures cost approximately $45 from a U.S. storehouse "requiring a signed form accepting responsibility for the reciept and attesting to the existence of adequate facilities and practices to work with potentially highly pathogenic materials".[53]

If nations or non-state actors choose not to deal with biological facilities, they can acquire certain biological agents from the natural resources.[54] Agents producing anthrax, the plague, brucellosis, tularemia, and smallpox are examples of those agents that can be isolated from natural resources. Tricothecene mycotoxins can be derived from corn, aflatoxin can be produced from peanuts, and ricin can be produced from castor beans.[55] Due to the dual use applications of biological agents, nations or non-state actors can acquire the needed supplies from readily

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[52]Douglass Jr., Joseph D. and Neil C. Livingstone. America the Vulnerable: The Threat of Chemical and Biological Warfare. (Lexington, Massachusetts: Lexington Books, 1987), 25.

[53]The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government Printing Office, 1995), 31. The cultural storehouses can supply different biological cultures, frozen or freeze-dried, to include anthrax and clostridium botulinum.

[54]Douglass Jr., Joseph D. and Neil C. Livingstone. America the Vulnerable: The Threat of Chemical and Biological Warfare. (Lexington, Massachusetts: Lexington Books, 1987), 23.

[55]Biological agent "recipes" can be obtained through open source documents. An example is Douglass/Livingstone's America the Vulnerable, pp. 23-24.

available facilities.

D. POSSIBLE DELIVERY SYSTEMS FOR BIOLOGICAL AGENTS

The full range of delivery systems must be taken into account when evaluating the overall proliferation capabilities of nations or non-state actors. Possible delivery systems for biological agents vary from the release of infected animals to warheads on a ballistic missile. From Appendix B, the main delivery systems for biological agents involve rudimentary methods such as catapulting dead infected bodies, trading contaminated materials, releasing agents while testing, releasing infected animals, contaminating food and water supplies, using bombs and rockets, using bulbs in subway stations, using spring type umbrellas, and using modified drop tanks. These rudimentary delivery systems have proven to be very effective. The more sophisticated delivery systems, such as warheads for ballistic missiles, contained biological agents, but never employed against other forces. It's only a matter of time when these crude delivery systems turn into more sophisticated delivery systems such as ballistic missiles. The problem with most delivery systems is that they are widely available on the international market.

A possible scenario could utilize the unmanned aerial

vehicles (UAVs) or model type airplanes capable of releasing biological agents. With the Navy's new role in littoral warfare, ships will operate close to land. This provides a perfect opportunity, especially at night, for a nation or non-state actor to employ biological agents against military forces. These delivery systems can pollute the surrounding air while depositing the biological agents on the surface of the naval vessel allowing the crew to carry the agents within the skin of the ship and contaminate a majority of the crew.

A second possible scenario could involve the contamination of food supplies destined for military platforms while in overseas ports. While these food supplies are being prepared for delivery, nations or non-state actors could easily contaminate the food prior to loading onboard military platforms, such as naval vessels. This method could also be used against an import or export of crops crippling the economy of that particular nation.

Another possible scenario could involve the contamination of Turkish water resources.[56] With the lack of water in Iraq and Syria, other nations or non-state actors could contaminate the Turkish water resource, which

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[56]Example from Butts, Kent Hughes. "Environmental Security: What is DOD's Role?", Strategic Studies Institute Review. (United States: U.S. Army College, May 28, 1993), 8.

supplies Iraq and Syria, in order to initiate a conflict in the region.

E. PROBLEMS WITH BIOLOGICAL WARFARE DETECTION

Detecting biological agents or biological warfare programs are serious worldwide problems. The dual use nature and potential illicit activities involving biological agents as well as the nature of biological agents themselves only encourage nations or non-state actors to utilize biological agents as possible weapon systems. Small biological facilities with limited staffs add to the list of problems when trying to detect biological installations.

Biological agents and the threat of biological warfare jeopardizes the international security. Biological agents have the potential to cause military, political, economic, and environmental insecurities throughout the world. NATO must intensify its efforts against the proliferation of biological agents and weapon systems.

IV. BIOLOGICAL AGENTS AND TERRORISM

The second reason why NATO should magnify all efforts against the proliferation of biological weapons and their means of delivery is the threat of terrorist activities involving biological weapons. NATO must face the realization that terrorist groups have the capabilities of producing and acquiring biological agents for employment against their targets. Biological terrorism can affect civilian populations, military forces and installations, water supplies, commercial industries, and medical facilities. As world medical and research facilities strive to control the biological agents in their natural state, terrorist groups or non-state actors will strive to gain an advantage by having biological weapon capabilities. Currently, the world is battling the effects of biological agents due to various outbreaks. These outbreaks have caused many problems throughout the world. As non-state actors notice these problems, they will realize that biological agents and weapons are a perfect combination for their particular organizations.

The Alliance is not embodied in a titanium fortress. Terrorism can strike at any place, any time.[57] Billy Payne,

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[57]"Terrorism is the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population or any segment thereof, in furtherance

head of the Atlanta Olympic Committee, stated that "the city would be the safest place on the planet" during the 1996 Olympic Games.[58] Even with military troops, explosive detectors, and the latest bomb technology, a simple pipe bomb exploded within the Olympic city killing one and injuring hundreds. This could have easily been substituted with a biological weapon from a non-state actor. It is the responsibility of the Alliance to provide security and peace for its members. NATO must face the seriousness relating to the threat of non-state actors with biological weapon capabilities. General Binford Peay stated that "terrorism is changing and the next attack could be a vial of anthrax thrown over the perimeter".[59] After the terrorist attack in Saudi Arabia against American military forces, the Defense Secretary William J. Perry announced the possibility of

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of political or social objectives." This definition was cited in Holms, John Pynchon with Tom Burke. Terrorism: The Complete Book of Terrorist Groups, Their Deadly Weapons, Their Innocent Targets, and Their Terrible War Crimes. (New York: Pinnacle Books and Windsor Publishing Corp, 1994), 1.

[58]Billy Payne was cited in Sherwood, Ben. "No Safe Place", New York Times. July 27, 1996.

[59]General Binford Peay, CINC of USCENTCOM, was cited in "USA & Saudi Must Bridge Gap to Counter Terrorism Says Perry", Jane's Defence Weekly. Vol. 26, No. 3. (United Kingdom: Jane's Information Group Limited, July 17, 1996), 18. General Peay made this statement at a July 9, 1996 hearing of the Senate Armed Services Committee.

groups having biological weapons.[60] NATO cannot allow these groups to have the upper hand. NATO must highlight biological warfare in their policies and demand the support from fellow nations. Winning these battles is a team effort.

Currently, there are seven nations accused of aiding terrorists: Syria, Iran, Iraq, Libya, North Korea, Sudan, and Cuba.[61] From this list of "terrorist aiding" nations, five nations are possibly involved in offensive biological weapons programs: Syria, Iran, Iraq, Libya, and North Korea.[62] Not only can these nations aid terrorist groups or other nations with biological weapons to threaten the securities and freedoms of nations around the world, they also have the capability to employ biological agents at long ranges. Since ballistic missiles are considered to be a delivery system for biological agents, Appendix H is

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[60]U.S. Defense Secretary, William J. Perry, was cited in "U.S. to Upgrade Security of Forces in Saudi Arabia", New York Times. July 18, 1996. The article also states that Iran and Iraq have called for the overthrow of the Saudi government. Both Iran and Iraq are currently on the nations who support terrorism list and nations involved with an offensive biological weapons program list.

[61]Associated Press. "U.S. Accuses 7 Nations of Aiding Terrorists", New York Times. May 1, 1996.

[62]These nations are among the list of nations involved in possible offensive biological weapons programs cited in U.S. Congress, Office of Technology Assessment. Technologies Underlying Weapons of Mass Destruction, OTA-BP-ISC-115. (Washington, D.C.: U.S. Government Printing Office, December 1993), 239.

provided to illustrate the current and future ranges of their ballistic missile systems.

A. BIOLOGICAL WEAPON ATTRACTION TO TERRORIST GROUPS

Terrorists with biological weapons is not a recent discovery. The combination of biological agents and weapon systems dates back to the early 1960's. Biological weapons have been very attractive to terrorist groups and will continue to increase in the present environment. There are many reasons why biological agents are attractive to terrorist groups. Some of these attractions are due to:

(a) the availability and low cost of the agents and equipment as compared to nuclear and chemical materials,

(b) the relative ease of producing, acquiring, or employing the agents,

(c) the lethality of the agents,

(d) the undetectability of the agents,

(e) the small amounts of agent needed to produce enormous problems for the target, and

(f) the large amount of fear from the populations that these agents create.

From Appendix B, terrorist groups seem to focus upon four main attractions: the ability to cause fear in the general population, the accessibility of biological agents, the relative ease of producing biological agents, and the relative ease of employing biological agents. These

attractions as well as the others mentioned above cannot be overlooked by NATO. NATO must establish policies that discourage terrorist groups from these attractions and create fears for those groups thinking about having biological weapon capabilities. NATO could highlight the unpredictability of biological agents, the dangers to personal safety, and the hazards of producing, storing, and employing biological agents.

B. TRENDS OF TERRORIST ACTIVITIES INVOLVING BW

NATO cannot underestimate the current trends of biological agents falling into the hands of terrorist groups. After analyzing the past three decades of Appendix B, the threat of biological terrorism is increasing despite the relatively low occurrences of the use or threat of employing biological agents within the current decade. The reasons for the relatively low reported occurrences are the advances in biotechnology and learning experiences from the past two decades.

In the 1970's, terrorist groups were experimenting with various biological agents in the bacterial, rickettsial, and toxin categories. These agents include typhoid, anthrax, botulism toxin, and ricin. Not only were terrorist groups producing biological agents, they were also employing

biological agents with unsophisticated delivery systems and methods. The delivery systems and methods included contaminating water resources, sending infected carriers in the mail, and injecting individuals with an umbrella gun. Although only two individuals were reported to have died from biological terrorism, terrorist groups illustrated the desire to produce agents, threaten to use agents, and actually use biological agents to carry out their missions.

In the 1980's, terrorist groups continued to produce and employ biological agents. They also attempted to steal biological agents from medical or research facilities. Biological agents within the bacterial, rickettsial, and toxin categories were not the only agents of interest. Terrorist groups expanded into the fungal category as well. The delivery methods also expanded into the contamination of food supplies and the Earth's surface.

The present decade is a little different than the past two decades. With the biotechnological advances in this decade, the reported cases involving biological terrorism is decreasing. This does not mean that the threat of biological terrorism is decreasing. Terrorist groups, such as the Japanese Aum Shinrikyo cult, have recently illustrated interest in obtaining viral agents. With this current interest, terrorist groups have now portrayed

interest in all areas of biological agents: bacterial, viral, rickettsial, fungal, and toxin. Terrrorist groups are currently using sophisticated biological equipment from the domestic or international market and showing interest in the more sophisticated delivery systems, such as aircraft and drones, as well.

In March 1995, the Japanese Aum Shinrkyo cult was involved in the Tokyo commuter train incident that claimed 12 lives and wounded over 5,000 other individuals.[63] This represents a new dimension of terrorism that will become an increasing security concern for the entire world. Although this particular terrorist group employed chemical weapons, other terrorist groups might view this occurrence as paving the way to employ other weapons of mass destruction: biological weapons.

The interesting points concerning the Japanese terrorist group is that it attracted many university graduates and successful professionals, possessed a sophisticated biological weapons program, and disclosed the network of members involving other nations. Some cult members were graduates from leading Japanese universities with scientific, medical, and engineering backgrounds and

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[63]Drew, Christopher. "Japanese Sect Tried to Buy U.S. Arms Technology, Senator Says", New York Times. October 31, 1995.

successful professionals with physics, chemistry, law, and medical backgrounds.[64] After the police raid of the Kamikuishiki compound, it was discovered that the cult had biological agent capabilities. The police found advanced DNA devices along with 160 large containers of peptone, a solution used to cultivate bacterial agents, clostridium botulinum, and other microorganisms.[65] There was also evidence that the cult attempted to obtain the ebola virus as well as aircraft and drones for means of delivery systems.[66] And the final point of interest involves the extensive network of members linked to North Korea and Russia, both of which are suspected of offensive biological warfare programs. The cult had 10,000 members in Japan and 30,000 members in North Korea and Russia.[67] Its only a matter of time before other terrorist groups illustrate such dangerous capabilities.

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[64]Croddy, Eric. "Urban Terrorism: Chemical Warfare in Japan", Jane's Intelligence Review. (United Kingdom: Huntcard Litho, November 1995), 520-523; Drew, Christopher. "Japanese Sect Tried to Buy U.S. Arms Technology, Senator Says", New York Times. October 31, 1995.

[65]Croddy, Eric. "Urban Terrorism: Chemical Warfare in Japan", Jane's Intelligence Review. (United Kingdom: Huntcard Litho, November 1995), 522.

[66]Douglass Jr., Joseph D. "Chemical and Biological Warfare Unmasked", Wall Street Journal. November 2, 1995.

[67]Ibid.

C. CHARACTERISTICS OF POTENTIAL GROUPS USING BW

Determining which group would actually use biological weapons is a difficult task. After analyzing Appendix B, there are certain characteristics associated with groups using biological weapons. First, the group would not be "concerned with the moral implications or the potential backlash" associated with biological weapons.[68] Second, the group would illustrate the willingness to take risks dealing with hazardous weapons. Third, the group would portray the willingness to challenge the security systems of medical or research facilities around the world to acquire biological materials. Fourth, the group would demonstrate the willingness and capability to use sophisticated or unsophisticated weapon systems against their targets. Fifth, the group would demonstrate the ability to cause death or incapacitate their intended targets and the possibility of innocent victims.

NATO must ban together to challenge the threat of biological terrorism. Ensuring the utilization of every available asset is critical when confronting the biological warfare threat. As the world struggles with various outbreaks caused by biological agents, terrorist groups will

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[68]Simon, Jeffrey D. Terrorists and the Potential Use of Biological Weapons: A Discussion of Possibilities, R-3771-AFMIC. (California: RAND Corp, December 1989), vi.

realize that biological agents provide an advantage for their particular groups. Striving for a more secure and peaceful environment is a team effort. Individual nations of NATO cannot challenge this threat by themselves. NATO must change its policies towards biological warfare and all members of NATO must support actions against those nations or groups who sponsor or utilize biological agents and weapons for terrorist activities.

V. INTELLIGENCE INVOLVING BIOLOGICAL WARFARE

Intelligence is highly significant in every aspect of biological warfare. The threat of biological warfare from nations or non-state actors must install a strong sense of concern for all intelligence agencies. Without prior intelligence or early warning, any biological attack has a high percentage of success. Worldwide intelligence groups must increase their involvement towards the nonproliferation of biological weapons before this increasing threat becomes uncontrollable.

NATO must know the capabilities of other nations and non-state actors.

> Know the enemy and know yourself, in a hundred battles you will never be in peril. When you are ignorant of the enemy but know yourself, your chances of winning and losing are equal. If ignorant of both your enemy and of yourself, you are certain in every battle to be in peril.[69]

The Alliance has the responsibility to protect its forces and territories. If NATO becomes complacent when dealing with the threat of biological warfare, surrounding nations and non-state actors will take advantage of the situation. The intelligence agencies within the Alliance must share information and intelligence gathering methods to combat

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[69]Sun Tzu cited in Joint Publication 2-0: Joint Doctrine for Intelligence Support to Operations. (Washington, D.C.: U.S. Government Printing Office, October 12, 1993), IV-9.

this probable nightmare.

Since biological weapons production and storage facilities can be disguised as commercial, pharmaceutical, medical, or research projects, intelligence agencies can provide the customer with a wealth of knowledge to fight against biological warfare. There are four main reasons why intelligence is such a significant factor when dealing with biological warfare: defusing threats and proliferation incentives, deterrence against biological weapons, destruction of biological facilities, and defense against biological weapons.[70] First, intelligence can defuse threats or proliferation incentives by "providing accurate, timely, and convincing threat detection and assessments, brokering disputes between states, and sharing technology to improve stability when proliferation occurs".[71] As nations or non-state actors proliferate such WMD, the biological arms race would pose numerous worldwide risks and dangers. Second, intelligence can deter against the proliferation and employment of biological weapons by "building accurate intelligence assessments for the potential use, maintaining credible deterrent threats to high value targets, and

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[70]Latter, Dr. Richard. "The Increased Danger of Biological Weapons Proliferation", Jane's Intelligence Review. (United Kingdom: Huntcard Litho, February 1994), 95.

[71]Ibid.

providing credible defense, recovery, and protective capabilities".[72] Third, intelligence can provide pertinent information in destroying biological facilities by "gethering tactical intel for targeting and damage assessment".[73] Accurate intelligence can reduce the possibilities of infecting individuals while destroying biological facilities. Fourth, intelligence can improve the defensive measures by "providing accurate and timely early warning and attack assessments, supplying effective passive protection measures, and using effective defensive and interdiction capabilities".[74]

A. INTELLIGENCE UNDERESTIMATES

There are two recent disclosures of intelligence underestimates that should encourage NATO to highlight the increasing threat of biological warfare and intelligence agencies to increase their efforts towards biological warfare: (1) the extensive Iraqi offensive biological weapons capabilities and (2) the extensive Russian biological weapons research programs. Both of these nations

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[72]Latter, Dr. Richard. "The Increased Danger of Biological Weapons Proliferation", Jane's Intelligence Review. (United Kingdom: Huntcard Litho, February 1994), 95.

[73]Ibid.

[74]Ibid.

have signed and ratified the BTWC and allegedly comitted violations of the agreement. NATO must put a stop to the proliferation of biological weapons.

1. Iraq

The first disclosure of an intelligence underestimation involves Iraq, a signatory who ratified the BTWC in 1972. Although intelligence was gathered on Iraq's ability to produce biological agents and test limited biological weapons, Iraqi advancements in the biological weapons field shocked intelligence agencies. In December 1991, Iraq filled 150 gravity bombs and 25 medium range missile warheads with botulinum toxin and anthrax, and 16 additional bombs were filled with aflatoxin which were relocated from Al Muthanna to two air force bases and a missile launch site for possible employment against U.S. and coalition forces.[75] Not only did the Iraqis inform agencies about the loaded missiles, but they also informed agencies about the increased anthrax production and delivery systems. Iraqi officials confessed that ten times more anthrax was produced vice the original amount reported and the development of drone type aircraft were capable of spraying agents into the air.[76] During the invasion of Kuwait, the Pentagon

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[75]Arms Control Today. "Iraq Provides IAEA With Significant New Information". Vol. 25, No. 7. (Washington, D.C.: Arms Control Association, September 1995), 27.

officials diminished "Iraq's ability to use biological and toxin agents".[77] Intelligence agencies should have been well aware of Iraq's biological capabilities prior to Persian Gulf War. Military forces would have been better prepared against a biological attack. Saddam Hussein claims to have destroyed biological agents after the Persian Gulf War, but has failed to produce any evidence illustrating such actions. The Iraqi president continues to block U.N. inspectors from entering buildings suspected of containing banned weapons. The United Nations estimate that Iraq purchased 39 tons of growth media before 1990 in which every ton can yield ten tons of bacteriological weapons.[78] Intelligence agencies must strive to accurately pinpoint these hazardous locations. Seventeen of the 39 tons of growth media, amounts that can kill 50-60 million individuals, are still unaccounted by the inspection teams.[79]

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[76]Ibid. 27 & 32. Iraqi officials admitted to these biological advances due to the defections of Saddam Hussein's two son-in-laws: LTGEN Hussein Kamel Hassan and Saddam Kamel Hassan who were responsible for developing WMD. For more information see Crossette, Barbara. "Iraq Probably Hiding Arms, Chief U.N. Inspector Says", New York Times. June 13, 1996.

[77]Tucker, Jonathan B. "Lessons of Iraq's Biological Weapons Programme", Arms Control. Vol. 14, No. 3. (London: Frank Cass, December 1993), 241.

[78]Bruce, James. "Playing Hide and Seek With Saddam", Jane's Defence Weekly. Vol. 25, No. 1. (United Kingdom: International Thomson Publishing, January 3, 1996), 19.

[79]Ibid.

2. Russia

The second diclosure of an intelligence underestimation involves the Russian Federation which has signed and ratified the BTWC and is a member of NATO's pfp program. Throughout the Cold War, Russian biological research programs, such as the Sverdlovsk research facility and the Biopreparat program, were very active.

In April 1979, an accidental release of anthrax from the Microbiology and Virology Institute in Sverdlovsk city caused many casualties and approximately 100 deaths between seven to ten days.[80] An estimated ten kilograms of anthrax spores were released in a two to three mile radius.[81] Vaccinations and antibiotic treatments were administered to the victims, but it was too late. The Soviet government denied the presence of a biological research facility and claimed the outbreak was caused by anthrax contaminated meat.

The Biopreparat program is the most significant biological research facility in Russia. This program began with a bright Russian scientist named Vladimir Pasechnik. Pasechnik was the senior director of the Institute of Highly

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[80]DIA. Soviet Biological Warfare Threat, DST-1610F-057-86. (Washington, D.C: U.S. Government Printing Office, 1986), 4-7.

[81]Ibid.

Pure Biopreparations between 1975 and 1989.[82]

Pasechnik's goals were for peace, not for the development of destructive weapons. But in 1974, the Soviet Ministry of Defense offered Pasechnik a job to organize a laboratory with unlimited funding: the beginning of the Biopreparat program.[83] Naturally, Pasechnik accepted the offer and began his work, unaware of the Soviet scheme and the BTWC agreement.[84] He slowly became a pawn for the Soviet military. After years of research, the Soviet government ordered Pasechnik to develop new diseases that were resistent to antibiotics of NATO forces and research the effectiveness of military type delivery systems.[85] As the number of laboratories expanded and stockpiles of biological agents increased, Pasechnik became uncomfortable about his role as a research scientist within this particular program.

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[82]Vladimir Pasechnik was interviewed on BBC News Night , January 21, 1993.

[83]The Sunday Times News Review. "The Untold Story of Russia's Secret Biological Weapons Program". March 27, 1994.

[84]According to Pasechnik's interview on January 21 ,1993, he became aware of the BTWC agreement after he arrived in the West.

[85]Other locations for biological research included Obolensk which researched lethal new bacteria, Koltsevo which researched viruses, Chekhov which researched ways of protecting their troops from biological agents, and Leningrad - St. Petersburg which researched agents more lethal power (genetic plague and tularemia). These locations were cited during the January 21, 1993 interview.

Paechnik knew the program was leaning toward military applications and decided to expose the program in other societies, particularly the West, in order to dismantle the program. When the Biopreparat began bargaining with manufacturing facilities in Toulouse, France in 1989, Pasechnik, with defecting intentions, volunteered to assist in finalizing the deal. Without knowing Pasechnik's true intentions, the government granted his request and when the Soviet group arrived in France, Pasechnik called the British embassy and eventually defected. The secrets of the Soviet biological weapons program now became headline news.

According to Pasechnik during the news interview, the Biopreparat also discussed issues relating to terrorism. He acknowledged the fact that the program could be useful for terrorist activities for the following reasons: the production of the biological agents and weapons were relatively easy and the difficulty to discover which nation or non-state actor was involved with a biological attack. This program extended well beyond the Soviet boundaries.

Despite the denial of a program to develop biological or toxin weapons by President Gorbachev on June 8, 1990, President Yeltsin admitted to the research in biological warfare programs and issued a decree designed to end the

Biopreparat program in April 1992.[86] Lawrence Eagleburger, former U.S. Secretary of State, believes that Yeltsin does not have total control or authority over all Russian activities which indicates the possibility of covert biological research activities.[87] He also believes that these programs could exist since Russian biologists need money to support their families and that there is a "conservative element unhappy with the detente between Russia and the West.

Nuclear and chemical weapons seem to receive more attention in the professional literature than biological weapons. The intelligence communities within the Alliance have definitely underestimated the biological programs of certain nations and non-state actors. Without prior intelligence and early warning, any biological attack has a high probability of success. Prior intelligence and early warning of biological attacks allows the target to use protective measures. NATO intelligence groups must increase their efforts towards biological warfare. If biological warfare programs of Iraq and Russia have been underestimated, then what is the real biological program status of other nations or non-state actors suspected

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[86]Vladimir Pasechnik was interviewed on BBC News Night , January 21, 1993.

offensive biological warfare programs?

B. ROLE OF HUMAN INTELLIGENCE (HUMINT)

Specific attention should be given to the role of human intelligence (HUMINT). Although technology has its advantages and verification methods for detecting biological weapons are problematic, HUMINT can play a vital role in the intelligence process. HUMINT agents can be positioned in embassies, universities, commercial companies, and even transportation services. It provides the enormous reporting advantage without the requirement of interpretation.

When dealing with collection, analysis, and covert action of the intelligence system, each one of these elements have to be carefully integrated. Each component affects the performance of the other components. The elements of HUMINT improves the collection, analysis, and covert action components of the intelligence system.

First, collection is the process of gathering information to support decision making. To utilize this particular element effectively, the intelligence group must know the limitations and capabilities of the accessible resources. Having information from all available sources creates a complete intelligence package. When HUMINT is not present in the collection process, two major problems exist:

(1) if the collection process does not include human resources to verify received information, the agency will only open the door for deception. HUMINT can provide information on technological targets or equipment in "hidden" areas and (2) if the collection process only includes a technological element, what happens when the weather causes problems with the equipment? HUMINT is needed to provide the additional information. Utilizing all available intelligence sources is the key to successful collection activities.

Second, analysis is the process of converting "raw" information into usable intelligence to support the decision making process. Timeliness and accuracy are very significant aspects during this process. When HUMINT is not present in the analysis process, one fundamental problem exists: verifying received information from other intelligence sources. Information could have been provided by a double agent. Technological sources, for example, could provide developed film, copied images, or converted messages, but verifying that information through human resources will decrease any chance of deception. HUMINT provides that necessary "second look".

Third, covert action is the process of influencing events in another state without revealing own involvement

usually in the form of propaganda, intelligence assistance, political assistance, or forceful activity. When HUMINT is not present in the covert action process, three major problems exist: (1) the protection of counterintelligence, with HUMINT, is necessary in avoiding the risk of manipulation or exposure by other intelligence services, (2) HUMINT involvement establishes the secrecy of such actions against other states. Technological means of covert action create a more noticeable operation which could be avoided with HUMINT sources and (3) HUMINT assists in ensuring that the correct government or group is influenced. HUMINT sources can provide propaganda and disseminate disinformation to influence the target.

The role of HUMINT in improving the intelligence process includes overt and covert operations. Overtly, attaches could interview military contacts or even militant radicals, agents could interview possible candidates in suspected organizations, and inspection teams could que signals intelligence (SIGINT) operations or tip other HUMINT agents. Covertly, official agents within an embassy could monitor any proliferation efforts and non-official agents could spread propaganda or unrealistic information about suspected biological events. Monitoring suspected biological facilities provides estimated stockpiles of

biological weapons or attempts to transfer biological weapons for possible use.

When dealing with collection, analysis, and covert action elements of the intelligence system, each one of these elements have to be carefully integrated. If the elements are not integrated properly, problems will occur. This clearly illustrates the complexity of the intelligence system and the importance of utilizing all available information and methods in creating the final product for success against the proliferation of biological agents, equipment, and weapons.

C. INTEGRATING INTELLIGENCE FINDINGS

The key to success is the proper combination of intelligence gathering sources and the swift process and dissemination of accurate data throughout the organization. The Joint Deployable Intelligence Support System (JDISS), with its intelligence link capability, serves as the global information gateway. This system allows nations, units, and individuals the access of pertinent information. JDISS capabilities include: "on-demand imagery and tactical intelligence on selected areas and targets, real-time information to transfer up, down, and across echelons, regardless of service, responsive and secure communications

with operational commanders, intelligence 'smart-push' database updates, and intelligence 'demand-pull' linked to onboard servers.[88] Intelligence relating to biological warfare should be separated between classified and unclassified information in order for military, civilian, research, and academic organizations to develop new ideas on combatting the threat of biological warfare. JDISS is the link needed to combine all efforts towards fighting against biological warfare. Nations, with this outstanding information capability, can work as teams to decrease the threat of biological warfare.

Intelligence provides specific details of the target which is the cornerstone in the planning process. With the support of other agencies, intelligence gathering will involve a wide variety of resources ranging from human contacts to satellite projects. Each of these resources provides its own variety of capabilities, methods, and sophistication. There might be some overlap in the process, but more information is better than not having enough information. The goal for any agency is establishing the proper mix of sensors and sources for better intelligence results.

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[88]Office of Naval Intelligence. Naval Intelligence: Ready For Joint Operations. (Washington D.C.: U.S. Government Printing Office, 1995), 10.

VI. CONCLUSION

The end of the Cold War unleashed a number of troubling developments in the world, especially the proliferation of weapons of mass destruction. Currently, nations as well as non-state actors are willing to buy or sell the technologies necessary to produce biological weapons that threaten the military, economy, and environment. Biological weapons are an increasing threat to world security.

NATO's current policies regarding WMD do not highlight the increasing threat of biological weapons. The threats of biological warfare require the same amount of attention that nuclear and chemical warfare receives within NATO policies. When policies indicate a higher concern towards biological warfare, intelligence agencies will increase their efforts towards biological warfare as well. NATO must face this dreadful challenge head on and continue to fight against the threat of biological warfare in order to maintain the security and peace of its members.

One reason why NATO should magnify all efforts against biological warfare is the potential hazards associated with biological agents. The world is battling against the rise of infectious diseases and the biological agents seem to be winning. As nations or non-state actors observe the increasing problems created by the biological agents, they

will realize that biological agents are proving to be an outstanding weapon of choice. The possession of biological agents for the use of biological weapons will have a direct impact on worldwide operations. Nations and non-state actors have accessibility to the necessary equipment for producing these agents and to the biological agents themselves. NATO cannot underestimate any nation or non-state actor from developing biological weapons.

The second reason why NATO should magnify all efforts against biological warfare is the threat of terrorist group activities involving biological weapons. The threat of biological terrorism is increasing. These groups have illustrated their interest in all areas of biological agents, sophisticated biological equipment, and sophisticated delivery systems over the past three decades.

Intelligence exists because of policies set forth by worldwide governments. NATO must change its policies towards biological warfare. New policies would enhance the efforts of intelligence agencies to "prevent acquisition, cap or roll back existing programs, deter the use of biological weapons, and ensure military forces can operate against these weapons".[89] If policies change, then

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[89]This is based upon a Col. Chuck Aldrich, USAF, brief on "Intelligence Issues in WMD: Nonproliferation and Counterproliferation" on July 22, 1996 at the Naval Postgraduate School. Col. Aldrich is currently Deputy Director of the DCI Nonproliferation Center, CIA.

intelligence will refocus their efforts towards the new changes: the increasing threat of biological warfare.

APPENDIX A

CONVENTION ON THE PROHIBITION OF THE DEVELOPMENT, PRODUCTION, AND STOCKPILING OF BACTERIOLOGICAL (BIOLOGICAL) AND TOXIN WEAPONS AND ON THEIR DESTRUCTION

The States Parties to this Convention,

Determined to act with a view to achieving effective progress towards general and complete disarmament, including the prohibition and elimination of all types of weapons of mass destruction, and convinced that the prohibition of the development, production and stockpiling of chemical and bacteriological (biological) weapons and their elimination, through effective measures, will facilitate the achievement of general and complete disarmament under strict and effective international control,

Recognize the important significance of the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on June 17, 1925, and conscious also of the contribution which the said Protocol has already made, and continues to make, to mitigating the horrors of war,

Reaffirming their adherence to the principles and objectives of that Protocol and calling upon all States to comply strictly with them,

Recalling that the General Assembly of the United Nations has repeatedly condemned all actions contrary to the principles and objectives of the Geneva Protocol of June 17, 1925,

Desiring to contribute to the strengthening of confidence between peoples and the general improvement of the international atmosphere,

Desiring also to contribute to the realization of the purposes and principles of the Charter of the United Nations,

Convinced of the importance and urgency of eliminating from the arsenals of States, through effective measures, such dangerous weapons of mass destruction as those using chemical or bacteriological (biological) agents,

Recognizing that an agreement on the prohibition of bacteriological (biological) and toxin weapons represents a first possible step towards the achievement of agreement on effective measures also for the prohibition of the development, production, and stockpiling of chemical weapons, and determined to continue negotiations to that end,

Determined for the sake of all mankind, to exclude completely the possibility of bacteriological (biological) agents and toxins being used as weapons, Convinced that such use would be repugnant to the conscience of mankind and that no effort should be spared to minimize this risk,

Have agreed as follows:

Article I

Each State Party to this Convention undertakes never in any circumstance to develop, produce, stockpile or otherwise acquire or retain:

(1) Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes;

(2) Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.

Article II

Each State Party to this Convention undertakes to destroy, or to divert to peaceful purposes, as soon as possible but not later than nine months after the entry into force of the Convention, all agents, toxins, weapons, equipment and means of delivery specified in article I of the Convention, which are in its possession or under its jurisdiction or control. In implementing the provisions of this article all necessary safety precautions shall be observed to protect populations and the environment.

Article III

Each State Party to this Convention undertakes not to transfer to any recipient whatsoever, directly or indirectly, and not in any way to assist, encourage, or

induce any State, group of States or international organizations to manufacture or otherwise acquire any of the agents, toxins, weapons, equipment or means of delivery specified in article I of the Convention.

Article IV

Each State Party to this Convention shall, in accordance with its constitutional processes, take any necessary measures to prohibit and prevent the development, production, stockpiling, acquiring, or retention of the agents, toxins, weapons, equipment and means of delivery specified in article I of the Convention, within the territory of such State, under its jurisdiction or under its control anywhere.

Article V

Each State Party to this Convention undertake to consult one another and to cooperate in solving any problems which may arise in relation to the objective of, or in the application of the provisions of, the Convention. Consultation and cooperation pursuant to this article may also be undertaken through appropriate international procedures within the framework of the United Nations and in accordance with its Charter.

Article VI

(1) Each State Party to this Convention which finds that any other State Party is acting in breach of obligations deriving from the provisions of the Convention may lodge a complaint with the Security Council of the United Nations. Such a complaint should include all possible evidence confirming its validity, as well as a request for its consideration by the Security Council.

(2) Each State Party to this Convention undertakes to cooperate in carrying out any investigation which the Security Council may initiate, in accordance with the provisions of the Charter of the United Nations, on the basis of the complaint received by the Council. The Security Council shall inform the States Parties to the Covention of the results of the investigation.

Article VII

Each State Party to this Convention undertakes to provide or support assistance, in accordance with the United Nations Charter, to any Party to the Convention which so requests, if the Security Council decides that such Party has been exposed to danger as a result of violation of the Convention.

Article VIII

Nothing in this Convention shall be interpreted as in any way lisiting or detracting from the obligations assumed by any State under the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on June 17, 1925.

Article IX

Each State Party to this Convention affirms the recognized objective of effective prohibition of chemical weapons and, to this end, undertakes to continue negotiations in good faith with a view to reaching early agreement on effective measures for the prohibition of their development, production, and stockpiling and for their destruction, and on appropriate measures concerning equipment and means of delivery specifically designed for the production or use of chemical agents for weapons purposes.

Article X

(1) The States Parties to this Convention undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the use of bacteriological (biological) agents and toxins for peaceful purposes. Parties to the Convention in a position to do so shall also cooperate in contributing individually or together with other States or international organizations to the further development and application of scientific discoveries in the field of bacteriology (biology) for prention of disease, or for other peaceful purposes.

(2) This Convention shall be implemented in a manner designed to avoid hampering the economic or technological development of States Parties to the Convention or

international cooperation in the field of peaceful bacteriological (biological) activities, including the international exchange of bacteriological (biological) agents and toxins and equipment for the processing, use or production of bacteriological (biological) agents and toxins for peaceful purposes in accordance with the provisions of the Convention.

Article XI

Any State Party may propose amendments to this Convention. Amendments shall enter into force for each State Party accepting the amendments upon their acceptance by a majority of the States Parties to the Convention and thereafter for each remaining State Party on the date of acceptance by it.

Article XII

Five years after the entry into force of this Convention, or earlier if it is requested by a majority of Parties to the Convention by submitting a proposal to this effect to the Depositary Governments, a conference of States Parties to the Convention shall be held a Geneva, Switzerland, to review the operation of the Convention, with a view to assuring that the purposes of the preamble and the provisions of the Convention, including the provisions concerning negotiations on chemical weapons, are being realized. Such review shall take into account any new scientific and technological developments relevant to the Convention.

Article XIII

(1) This Convention shall be of unlimited duration.

(2) Each State Party to this Convention shall in exercising its national sovereignty have the right to withdraw from the Convention if it decides that extraordinary events, related to the subject matter of the Convention, have jeopardized the supreme interests of its country. It shall give nmtice of such withdrawal to all other States Parties to the Convention and to the United Nations Security Council three months in advance. Such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests.

Article XIV

(1) This Convention shall be open to all States for signature. Any State which does not sign the Convention before its entry into force in accordance with paragraph (3) of this Article may accede to it at any time.

(2) This Convention shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Socialist Republics, which are hereby designed the Depositary Governments.

(3) This Convention shall enter into force after the deposit of instruments of ratification by twenty-two Governments, including the Governments designated as Depositaries of the Convention.

(4) For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Convention, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

(5) The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or of accession and the date of the entry into force of this Convention, and of the receipt of other notices.

(6) This Convention shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Naions.

Article XV

This Convention, the English, Russian, French, Spanish and Chinese texts of which are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of the Convention shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding states.

IN WITNESS WHEREOF the undersigned, duly authorized, have signed the Convention.

DONE in triplicate, at the cities of Washington, London, Moscow, this tenth day of April, one thousand nine hundred and seventy-two.

Source: GAO Report. Arms Control: U.S. and International Efforts to Ban Biological Weapons. (Washington, D.C.: U.S. Government Accounting Office, December 1992), 38-43.

APPENDIX B

AN HISTORICAL BIOLOGICAL AGENT DATA BASE

PRIOR TO 1910				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
Dark & Middle Ages	Cholera Outbreak	Cholera	Environment	**# Deaths**: Millions in Asia
13th/14th Century	"Black Death"	Bubonic Plague	Environment	**# Deaths**: Full quarter of Europe
1346-1347	Mongol Conflict	Bubonic Plague	Military and Environment	The Tartars infected the Genoese by catapulting infected bodies over the walls of the Crimean seaport Caffa (Feodosija). The plague also spread into Sicily, Sardinia, Corsica, and Genoa as plague victims fled via ships. **# Deaths**: UNK
1710	Russo-Swedish War	Bubonic Plague	Military	Reports of catapulting infected bodies into the battlefield. **# Deaths**: UNK
1741	Mexico & Peru Incident	Yellow Fever	Military	English commander, Admiral Edward Vernon, reported to have lost 20,000 of 27,000 men during the English attack to conquer Mexico and Peru. **# Deaths**: 20,000
1763	French-Indian War	Smallpox	Military	Captain Ecuyer of the Royal Americans met two indian chiefs and gave them Smallpox infected blankets. A Smallpox outbreak navigated through the tribes in Ohio. **# Deaths**: UNK
1764	Smallpox Outbreak	Smallpox	Environment	**# Deaths**: 1/10 of Swedish population succumbed

1910 - 1920				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
1914	World War I	Epidemic Typhus	Military and Environment	Typhus outbreak weakened the Russian forces. **# Deaths**: 3 million+ Russians

1914	World War 1	Anthrax and Glanders	Military and Environment	The United States discovered that German intelligence operations attempted to infect horses and mules. **# Deaths**: UNK
1918-1919	Influenza Outbreak	Influenza	Military and Environment	This outbreak affected the forces at the end of World War I and continued until 1919. **# Deaths**: 20 million worldwide

1920 -1940				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
1936-1945	Japanese Biological Program	Anthrax Plague Cholera and Typhoid	Military and Environment	Approximately 2,000 POW's were used as expermental guinea pigs. China claims that 11 cities were affected from the Japanese experiments with the Plague involving 700 cases. The Japanese BW factory was located near Harbin, in Manchuria. **# Deaths**: UNK

1940 -1950				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
1940	British Biological Program	Anthrax	Military	Britain intiated its Biological Weapons program involving Anthrax. Tests were conducted on Gruinard Island, Scotland near Laide. These bombs released spores that remained on the top 6-8 inches of soil for more than 40 years. **# Deaths**: UNK
1941	World War II	Epidemic Typhus	Military	The Soviet Union claims that the Germans used this disease against Soviet forces. **# Deaths**: UNK
1941	World War II	Various Agents	Military	Unit 731 under LTGEN Shio Ishii in Manchuria killed 3,000 individuals involving biological experiments. Most were Chinese, Russian, British, Australian, and American POW's. This unit also set up flea "nurseries" for the production of 135 million plague-infested fleas every 4 months. The delivery systems consisted of porcelain bombs containing 30,000 fleas. **# Deaths**: 3,000
1942	British Biological Program	Anthrax	Military	More tests conducted involving Anthrax weapons. **# Deaths**: UNK

1943	U.S. Biological Program	Anthrax	Military	A pilot Anthrax production plant became operational at Camp Detrick, MD. It consisted of approximately 500 staff members. This was created to produce large quantities of Anthrax for use in a bombing campaign against Germany during WW II. **# Deaths:** N/A
1945	U.S. Biological Program	Anthrax and Botulinum Toxin	Military	A decision was made to build a full-scale plant in Vigo, Indiana staffed with approximately 1,000 workers in order to produce 500,000 Anthrax bombs a month or 250,000 Botulinum Toxin bombs. The plant was completed in 1945, but was never placed in production. **# Deaths:** N/A
1946	Foot-and-Mouth Outbreak	Foot and Mouth Disease Virus	Environment	This outbreak occurred in Mexico which infected one-third of Mexico's cattle. 500,000 cattle were slaughter and thousands of others were innoculated. **# Deaths:** 500,000 cattle

1950 - 1960				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
1950	U.S. Biological Program	Bacteria Pathogens	Military	U.S. Congress voted to build a biological production plant, the X-201, near Pine Bluff, Arkansas with 10 fermenters for mass production processess. **# Deaths:** N/A
1951	U.S. Biological Program	Cereal Rust Spores	Military and Environment	The first anti-crop cluster bombs were placed in production for the U.S. Air Force. Each bomblet consisted of contaminated turkey feathers (cereal rust spores) **# Deaths:** N/A
1951	Korean War	Plague	Military	Koreans claim the United States used the Plague against Korean forces. **# Deaths:** UNK
1952	China Conflict	Anthrax Plague and Cholera	Military	Peking claims that biological warfare was initiated against Northeastern China. **# Deaths:** UNK
1953	Junin Virus Outbreak	Junin Virus	Environment	This rodent-borne virus casuseds hemorrhagic fevers which killed 1 of 5 victims by 1953. Apparently, the urine and droppings in dust particles caused the epidemic (easily inhaled). **# Deaths:** UNK

1960 - 1970				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
1960	U.S. Biological Program	Various	Military and Environment	The U.S. Army began developing a drone aircraft capable of delivering 200 pounds of biological agents as far as 115 miles. **# Deaths**: N/A
1961	Oropouche Virus Outbreak	Oropouche Virus	Environment	This outbreak caused flu-like symptoms in 11,000 individuals in Belgium and Brazil. This disease was transported by the midge or sandfly. **# Deaths**: UNK
1967	Ebola Outbreak (Marburg)	Ebola Virus	Environment	Thirty-one individuals were infected with the Marburg Ebola virus in West Germany and Yugoslavia. The virus was transported by Ugandan Green monkeys. **# Deaths**: 7
Late 1960's	U.S. Army Experiments	Harmless Bacteria Samples	Terrorism Scenario	The U.S. Army revealed the vulnerability of New York City's subway system to a biological attack. Aerial clouds of a harmless bacteria were sprayed through sidewalk vents into subway stations in Manhattan. Bacteria travelled by the wind of the speeding trains throughout many stations. In addition, light bulbs containing the bacillus were tossed from the trains into subway tunnels. Also, colored dye placed in water system of government buildings in Washington, D.C. **# Deaths**: N/A

1970 - 1980				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
Early 1970's	United States Incident	Various Bacteria	Environment and Terrorism	An attempt by a U.S. leftest terrorist group, Weather Underground, to blackmail a homosexual officer at the U.S. Army bacteriological warfare facility in Fort Detrick, MD, into supplying organisms to contaminate the water supply of a city or cities in the United States. **# Deaths**: N/A
1972	Chicago Water Supply Incident	Typhoid and other Deadly Bacteria	Environment and Terrorism	Two college students charged with conspiracy to commit murder for the plot to poison Chicago's water supply system. **# Deaths**: N/A
1973	German Incident	Anthrax and Botulinum Toxin	Environment and Terrorism	A German biologist threated to contaminate water supplies with bacilli of Anthrax and Botulinum unless he was paid $8.5 million. **# Deaths**: N/A

1974	Iraqi Biological Program	N/A	N/A	Iraq adopts a Biological Warfare policy. # **Deaths**: N/A
1974-1980's	Russian Biological Program	Various Agents	Military	The Russians initiated an intense biological warfare program focussing against NATO and Chinese forces. The program code-name was Biopreparat. # **Deaths**: N/A
1975	Iraqi Biological Program	Various Agents	Military	Iraqi officials increase research & development in the biological warfare field. # **Deaths**: N/A
1975	Symbionese Liberation Army Incident	Various Agents	Terrorism	This group was discovered to possess military technical manuals on how to produce biological agents for germ warfare. # **Deaths**: N/A
1976	Ebola Outbreak (Zaire)	Ebola Virus	Environment	The Ebola outbreak infected individuals from Zaire and neighboring Western Sudan. # **Deaths**: 400^{+}
1976	United States Incident	Various Bacteria	Terrorism	Executives throughout the United States were receiving "tick letters" which contained disease infected ticks according to the accompanied letter. # **Deaths**: UNK
1977	Rift Valley Fever Epidemic	Rift Valley Fever Virus	Environment	The Rift Valley Fever epidemic spread through Egypt's Nile River delta area infecting approximately 10,000 individuals. # **Deaths**: UNK
1978	Water Supply Target	UNK	Environment and Terrorism	Threats were made to contaminate the water supply of Phoenix, Arizona if extortion payments were not made. # **Deaths**: N/A
1978	Bulgarian Incident	Ricin	Terrorism	Ricin was used against two Bulgarian defectors. Since shooting the two individuals would draw unwanted attention, a Bulgarian agent filled an umbrella with Ricin pellets to shoot them into the legs of the victims. # **Deaths**: UNK
1979	Sverdlovsk Explosion	Anthrax	Environment	The Sverdlovsk explosion involving the Anthrax agent caused political tension between the United Kingdom, United States, and Russia. This eventually led to the Trilateral Agreement. # **Deaths**: 100^{+}
1979	Palestinian Biological Agent Usage	Clostridium Botulinum	Terrorism	West German reports indicate that the Palestinians in Lebanon were training the leftist RAF (Red Army Faction), remnants of the Baader-Meinhof gang, to use biological agents. A few years earlier, the Baader-Meinhof group threatened to poison the water supply in 20 West German towns if 3 radical lawyers were not allowed to defend their comrades. # **Deaths**: N/A
1970's	Dengue Fever Virus Outbreak	Dengue Fever Virus	Environment	This mosquito-borne tropical virus infected parts of the population in Asia and Latin America since the mid-70's. This virus appeared again in 1990 infecting 116,000 in Latin America. # **Deaths**: UNK

1980 - 1990				
Date	**Event**	**Biological Agent**	**Military, Environment, or Terrorism**	**Remarks**
Early 1980's	Iran-Iraq War	UNK	Military	Throughout the Iran-Iraq War, reports indicate the usage of biological agents. This alarmed politicians which caused the formation of the Australian Group. **# Deaths**: UNK
1980	Lake Tahoe Incident	UNK	Terrorism	Two casinos were sent extortion notes demanding $10 million to prevent the poisoning of their water supplies. **# Deaths**: N/A
1980	Police Raid on RAF Apartment	Clostridium Botulinum	Terrorism	The police raid ocurred in Paris and found a miniature lab containing a medium culture of Clostridium Botulinum to produce the Botulism Toxin. **# Deaths**: N/A
1981	Porton Down, Wiltshire Incident	Anthrax	Environment and Terrorism	Protestors deposited Anthrax spores, "seeds of death", in the ground at the Chemical Defence Establishment and at the Blackpool Tower. The spores were taken from Gruinard Island. The protestors wanted the spores brought back where they came from. **# Deaths**: N/A
1983	United States Incident	Ricin	Terrorism	FBI arrested 2 brothers in northeastern United States of manufacturing an ounce of nearly pure Ricin which was stored in 35 mm film canisters. **# Deaths**: N/A
1984	Canadian Incident	Botulism and Tetanus	Terrorism	Two Canadians were arrested in Buffalo, New York for placing orders with a U.S. research firm for these particular cultures. The 2 claimed to be representatives for a research company that did not exist. **# Deaths**: N/A
1984	Australian Incident	Foot & Mouth Bacteria	Terrorism	Australian authorities received an anonymous threat warning that the bacteria would be released if reforms in Queensland prison were not implemented. **# Deaths**: N/A
1984 (September)	Oregon Incident	Typhoid	Terrorsim	The Rajneesh cult outside Antelope, Oregon was reported to have contaminated the salad bars of local restaurants in The Dalles, Oregon with Typhoid which sickened 750 individuals in order to influence a local election. **# Deaths**: 750 individuals sick
1988 (March)	Iraqi Biological Program	Anthrax and Botulism Toxin	Military and Environment	Static field tests and trials of an Anthrax simulant and Botulism toxin with aerial bombs were tested on animals. **# Deaths**: N/A
1988 (September)	Kurd-Iraqi Incident	Typhoid	Military	The Kurds claim they were attacked with Typhoid bombs in Sulaymaniyah by the Iraqis. **# Deaths**: UNK

1989	Ebola Outbreak	Ebola	Environment	This outbreak occured in a primate center in Reston, Virginia. For fear of the virus spreading to other cities, the military was called for assistance to secure the area and kill the 400 monkeys. # **Deaths**: 400 monkeys
1989 (August)	Canadian Incident	Fungas Fusarium	Terrorism	A Canadian vetrinary pathologist reported to have received an Iranian pharmacologist request for 2 strains of the agent which is fatal to humans and animals within 24 hours if ingested. The request was denied. Another similar request by the same Iranian "researcher" to the Central Bureau for Fungas Cultures in the Netherlands. # **Deaths**: N/A
1989 (November)	Iraqi Biological Program	UNK	Military and Environment	Additional tests involving biological weapons were tested with the 122 mm rocket. # **Deaths**: N/A
1989	Baader-Meinhof Gang Incident	Clostridium Botulinum	Terrorism	A cell of the Bader-Meinhof gang was discovered with a culture of Clostridium Botulinum. # **Deaths**: N/A

1990 - PRESENT

Date	Event	Biological Agent	Military, Environment, or Terrorism	Remarks
1990 (May)	Iraqi Biological Program	N/A	Military	Previous incidents involved the testing of the 122 mm rocket with biological weapons. Now, additional firings of the 122 mm rocket were conducted. # **Deaths**: N/A
1990 (August)	Iraqi Biological Program	Clostridium Perfringens	Military	Iraq produced 340 liters. # **Deaths**: N/A
1990 (November) - 1991 (January)	Iraqi Biological Program	Botulism Toxin and Anthrax	Military and Environment	Iraq produced 5.4 thousand liters of Botulism Toxin at the Daura Foot & Mouth Disease Institute, 400 liters of Botulism Toxin at the Taji facility, and 150 liters of Anthrax at the Salmon Pak facility. # **Deaths**: N/A
1990 (December)	Iraqi Biological Program	Anthrax and other Agents	Military	Large scale weaponization of biological agents ocurred. Iraqi military filled 150 bombs and 50 warheads with biological agents and transported to forward locations. The Iraqis worked to adopt the modified aircraft drop tank with biological agent spray either to piloted fighter or remotely piloted aircraft guided by piloted aircraft. The spray was designed for 2,000 liters of Anthrax. The intial test failed, but three other tests conducted. # **Deaths**: N/A
1990	Iraqi Biological Program	Anthrax and Botulism Toxin	Military and Environment	Iraq produced 6,000 liters of Botulism Toxin and 8.425 thousand liters of Anthrax at the Al Hakan facility. # **Deaths**: N/A

Late 1990 - 1991	Persian Gulf War	Botulism Toxin and Anthrax	Military	Iraqi military weapons were illustrated as threats for the fear of nuclear attacks. # **Deaths**: N/A
1990	Sabia of Sao Paulo, Brazil Incident	Sabia	Environment	Yale scientist accidently infected himslf, but survived. # **Deaths**: N/A
1992	Yellow Fever Outbreak	Yellow Fever	Environment	This mosquito-borne disease occurred in Kenya. # **Deaths**: 29
1993	Hantaan Virus Outbreak	Hantaan Virus	Environment	The East Asian rodent-borne virus appeared in Southwest United States involving 106 cases in which 50% were fatal. This virus was also reported in 23 other states. The mild winter brought the field mice in contact with humans. # **Deaths**: 12
1993	Cryptosporidios Outbreak	Cryptosporidios	Environment	This outbreak occurred in the Milwaukee water supply system that sickened apporoximately 400,000 individuals. # **Deaths**: N/A
1994 (June)	Aum Shinrikyo Cult	N/A	Environment and Terrorism	Unveilling information of the cult attempts to acquire a biological agent and acquisitions of delivery systems. # **Deaths**: N/A
1994	Machupo Outbreak	Machupo Virus	Environment	This rodent-borne virus infected 7 individuals in northern Bolivia. # **Deaths**: 6
1995	Ebola Virus Outbreak (Kikwit)	Ebola Virus	Environment	This particular Ebola virus outbreak infected 316 individuals. # **Deaths**: 246
1995	Lassa Fever Virus Outbreak	Lassa Fever Virus	Environment	This virus causes African hemorrhagic fevers that infects 200,000 - 400,000 individuals annually in West Africa. # **Deaths**: Approximately 5,000 annually
1996 (February)	Ebola Virus Outbreak (West Africa)	Ebola Virus	Environment	A dead chimpanzee was eaten during a feast # **Deaths**: 13
1996 (February - May)	Meningitis Outbreak	Meningitis	Environment	This outbreak ocurred in West Africa which blocked pilgrimages. # **Deaths**: 10,000+
1996 (April)	Ebola Virus Outbreak	Ebola Virus	Environment	The Ebola virus (Reston) outbreak occured in Texas. Although this particular Ebola virus had no danger to humans, 100 infectuous monkeys from the Philippines were killed. # **Deaths**: 100 monkeys
1996	May 96 Report	Cholera	Environment	# **Deaths**: 1.3 million patients since 1991
1996	May 96 Report	TB	Environment	The report estimates an increase in TB patients. There is also an increase of a 58% death rate caused by biological agents between 1980-1992. The increase is 22% without AIDS. # **Deaths**: UNK

1996 (June)	Cyclospora Outbreak	Cyclospora	Environment	The outbreak has made more than 1 thousand individuals sick in 11 states (United States and Canada). This has caught federal officials by surprise. Guatemalan rasberries are linked to the outbreak. Californian strawberries were wrongly accused and the industry lost millions of dollars. **# Deaths:** N/A
1996 (July)	O-157 Colon Bacillus Outbreak	O-157 Colon Bacillus	Environment	The outbreak occurred in Japanese schools (53 of 92 primary schools in Sakai) and caused over 9,000 individuals to become ill. It also forced a widespread canx of classes. It also caused the cancellation of camping trips, athletic events, and summer festivals forcing individuals inside since the transmission can be from water. Warnings were issued about eating raw meat throughout Japan. Researchers claim radish sprouts is the carrier of the bacteria in Sakai, but still not positive. **# Deaths:** 10
1996 (August)	Cholera Outbreak	Cholera	Environment	The outbreak occurred in Mongolia and infected 92 individuals. A total of 1,901 individuals remained in quarantine. The virus has been traced to a military unit in Khoetol, in northern Mongolia, and was probably spread by contaminated food. **# Deaths:** 8
1996 (September)	Bubonic Plague Outbreak	Bubonic Plague	Environment	The plague occurred in Santa Clara county. It has been found in several wild animals (bobcats, wild pigs, and coyote) in the mountains east of Gilroy. The plague was passed via flea bites. **# Deaths:** 0

Sources adapted from: Altman, Lawrence K. "Cyclospora Outbreak Poses Many Puzzles", Monterey County Herald Tribune. June 30, 1996. pp. A1, A8; Associated Press. "Cholera Strikes Mongolia", New York Times. August 19, 1996; Associated Press. "Ebola in Texas Poses No Threat, Officials Say", New York Times. April 17, 1996; Associated Press. "Ebola Killed 13 in Gabon, W.H.O. Says", New York Times. February 19, 1996; Associated Press. "Guatemala Rasberries are Linked to Parasite", Monterey County Herald Tribune. July 19, 1996; Associated Press. "Japan Says Radishes Caused Food Poisoning", New York Times. August 8, 1996; Bruce, James. "Playing Hide and Seek with Saddam", Jane's Defense Weekly. Vol. 25, No. 1. (United Kingdom: International Thomson Publishing, January 3, 1996), 15-19; Cowley, Geoffrey. "Outbreak of Fear", Newsweek. May 22, 1995. pp. 48-55; DIA. Soviet Biological Warfare Threat. (Washington, D.C.: U.S. Government Printing Office, 1986), 4-7; Douglass, Joseph D. Jr. "Chemical and Biological Warfare Unmasked", Wall Street Journal. November 2, 1995; Douglass, Joseph D. Jr.and Neil C. Livingstone. America the Vulnerable: The Threat of Chemical and Biological Warfare. (Lexington, MA: Lexington Books, 1987), 31-32; CNN Presents. "Apocalypse Bug", July 21, 1996; French, Howard W. "Wide Epidemic of Meningitis Fatal to 10,000 in West Africa", New York Times. May 8, 1996; Geissler, Erhard. Biological and Toxin Weapons Today. (Stockholm International Peace Research Institute: Oxford University Press, 1986), 7-10; Goven, Gregory G. "An In-Depth Look at On-Site Inspections", Arms Control Today. Vol. 25, No. 7. (Washington, D.C.: Arms Control Association, September 1995), 27; Hanley, Charles J. "Infectious Diseases Making Comeback", Monterey County Herald Tribune. May 5, 1996; Jenkins, Brain M.

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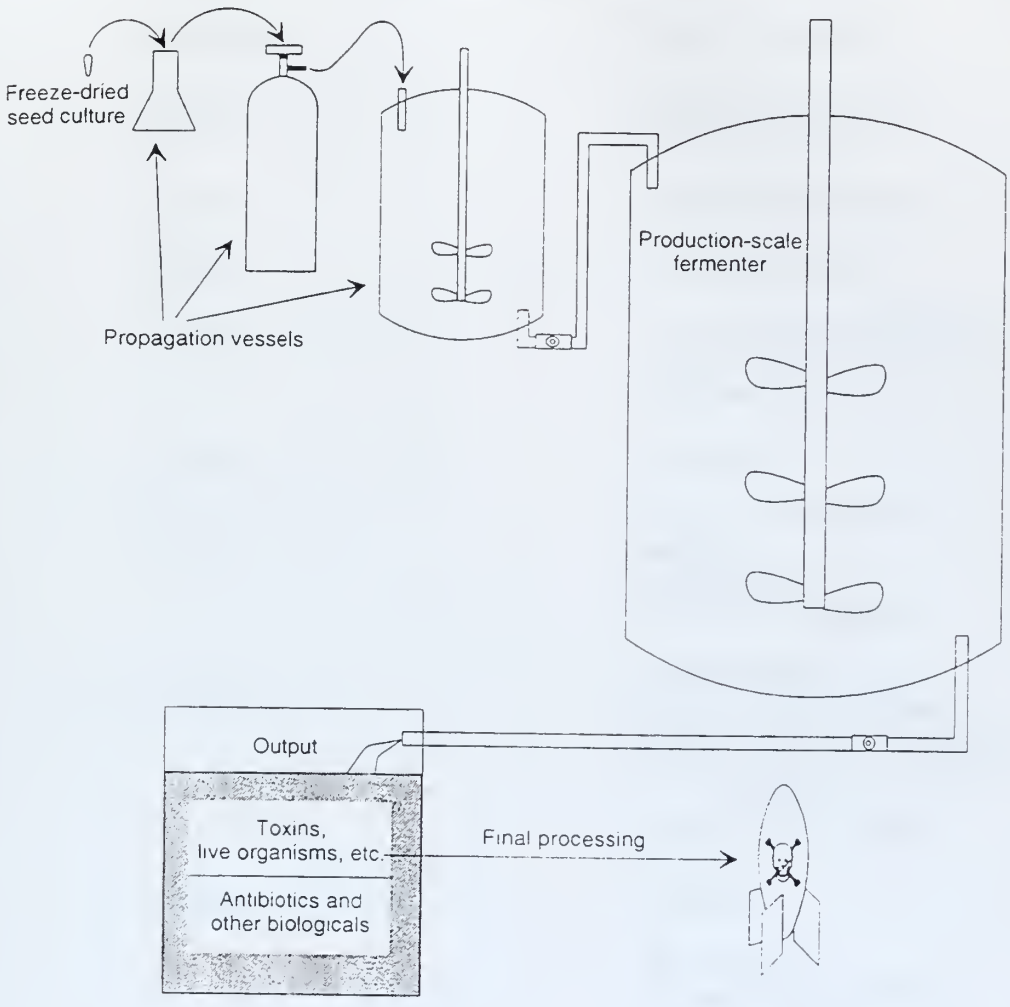
APPENDIX C

PRODUCTION OF BIOLOGICAL AGENTS BY FERMENTATION



Source: U.S. Congress, Office of Technology Assessment, Technologies Underlying Weapons of Mass Destruction, OTA-BP-ISC-115 (Washington, D.C.: U.S. Government Printing Office, December 1993), 87.

APPENDIX D

CONFIRMED WORLDWIDE MANUFACTURERS of FERMENTERS

(Manufacturers Capable of Producing Fermenters of 100 liters or greater)

(AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Australia	B Braun Australia Pty, Ltd. Sulzer Australia Pty, Ltd.
Austria	Andritz Maschinenfabrik AG
Belgium	Sulzer Belgium SA/NV
Canada	Pegasus Industrial Specialties, Ltd. Sulzer Canada, Inc. WHE Process Systems, Ltd.
Denmark	Alfa-Laval AS
France	Chemap (made in Switzerland) Inceltech LSL Biolafitte SA Sgi Setric Genie Industriel
Germany	Alfa-Laval Industrie GmbH B Braun Diessel Biotech GmbH Chemap GmbH (made in Switzerland) New Brunswick Scientific GmbH (made in U.S.) Sulzer-Escher Wyss GmbH
Hungary	Vegyepszer
Italy	Alfa-Laval SpA B Braun Milano SpA (made in Germany)
Japan	B Braun Biotech Co., Ltd. (made in Germany and Malaysia) Marubishi Bioengineering Co., Ltd. Mitsuwa Rikagaku Kogyo Co., Ltd.
Netherlands	Applikon Dependable Instruments BV Sulzer Nederland BV
Sweden	Chemoferm AB

	Electrolux Fermentation
Switzerland	Bioengineering AG Chemap AG LSL Secfroid SA MBR Bio Reactor AG
United Kingdom	B Braun Medical, Ltd. Bioengineering UK, Ltd. Centech, Ltd. FT Applikon, Ltd. LH Fermentation, Ltd. Life Sciences Laboratories, Ltd. MBR Bio Reactor (UK), Ltd. Sulzer (UK), Ltd.

(NON-AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Brazil	Sulzer do Brazil SA Industria e Comercio
Bulgaria	Scientific Research Lab for Instrument Making and the Automation of Biological Experiments
Czech Republic and Slovakia	Kralovopolska Stroyirna
Russia and other NIS	All-Union Scientific Research Design Institute of Applied Biochemistry Institute of the Biochemistry and Physiology of Microorganisms Irkutsk Scientific Research Institute of Chemical Machines NPO Biopribor NPO Biotekhnika Special Design Bureau for Biological Instruments
South Korea	Korean Fermentor Co.

UNCONFIRMED WORLDWIDE MANUFACTURERS of FERMENTERS

(Manufacturers Capable of Producing Fermenters of 100 liters or greater)

(AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Australia	Bulkon Australia Pty, Ltd. Cawthron Institute
Austria	Arge Biotechnologie Raiffeisen-Bioforschung Vogelbusch
Belgium	Belgolab SA Biotim N.V. Elscolab NV Holurieka NV Microgon, Inc.
Canada	Mueller Canada, Inc. The SNC Group St. Lawrence Reactors, Ltd. Techneurop, Inc. Wardrop Engineering, Inc.
Finland	G. W. Berg & Co., AB Rintekno OY
France	Bertin & Cie Bignier Schmid Laurent Biolog BSL Industries SA CCM Cellier SA Flobio Goavec Interscience Lequeux Pharmacia LKB Instruments SA Sonertec
Germany	Aluminiumgiesserei Neukoelin Oskar Waltersdorf GmbH Atlantik Geraetebau GmbH Bioinvest Engineering Buero Biotechnik Deutsche Metrohm GmbH & Co. Diessel GmbH & Co. Fr Kammerer GmbH Friedrich & Hoffmann

	Heinrich Frings GmbH
	Holag Technologie AG
	Holureika GmbH
	IBL GmbH
	IMA GmbH
	Kalger GmbH
	KC Biological
	Kraftanlangen Heidelberg AG
	Lang Labortechnik
	Membran-Tecnik-Hamburg
	PRG Praaezisions-Ruehrer GmbH
	Schuett Labortechnik GmbH
	Siemens AG
	Then Maschinen un Apparatebau GmbH
	VEB Chemieanlagenbaukombinat
Hungary	Mafki Ungar, Erdoel-und Erdgas Forschunginstitut
	Magyar Tudomanyos Akademia
Ireland	P J Brennan & Co., Ltd.
Italy	A Biotec
	Olsa SpA
	Oxytek SAS
	Vismara Associates SpA
Japan	Fuji Electric Co.
	Hirayama Manufacturing Corp.
	Hitachi, Ltd.
	Idemitsu Kosan Co.
	Kawasaki Heavy Industries
	Mitsubishi Heavy Industries
	Nippon Kokaan K.K.
	Nisshin Oil Mills, Ltd.
	Yakult Honsha Co., Ltd.
Netherlands	Amsterdam Valve & Fitting BV
	APV Nederland BV
	Bert Versteeg-Veetech BV
	Contact Flow
	Dalton BV
	Holurieka Holding BV
	Lameris Laboratorium
	Marius Instruments
	Netherlands Institute for Dairy Research
	Pharmacia Nederland BV
	Rhone Poulenc Nederland BV
	Salm & Kipp
	Vogelaar Electronics

Spain	CETS Institut Quimico de Sarria Knoik Instruments SA
Sweden	Biolink Ninolab AB
Switzerland	Amicon Division Arbeitsgemeinschaft Bioenergie Lonza, Ltd. Rosenmund AG
United Kingdom	Alcon Biotechnology, Ltd. Alfa-Laval Engineering, Ltd. Anglicon Instruments, Ltd. APV Baker APV Barnetta Rolfe, Ltd. B & P Biotechnology, Ltd. BS Flocor, Ltd. Catalytic International, Inc. Charles River UK, Ltd. Chemquip, Ltd. Dulas Engineering, Ltd. ECC International, Ltd. Endotronics Fairey Engineering, Ltd. GB Biotechnology, Ltd. Henfrey & Co., Ltd. Hickey & Co., Ltd. Imprial Biotechnology, Ltd. Life Technologies, Inc. Lummus Crest, Ltd. MacLeod & Miller (Engineers), Ltd. Mass Transfer International Matthew Hall Engineering, Ltd. National Engineering Laboratory NEBC Developments Penrhos Electronics Pharmacia-LKB Biochrom, Ltd. Roth Scientific Co., Ltd. Schaefer Instruments, Ltd. Sgi (UK), Ltd. Techmation, Ltd. TechnoGen Systems, Ltd. Titanium Fabricators, Ltd.

(NON-AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Brazil	Biobas Centro de Technolgia Promon

	CESCMT Com & Repr, Ltd. Codistil Coperucar Dedini SA Faculdade de Engenharia Industrial Setal Instalacoes Industrias SA TECHPAR Zanini SA Equipmentos
Czech Republic and Slovakia	Kovodruzhstvo Microbiology Institute of the Czechoslovakia Academy of Sciences Yednotne Zemyedyelske Druzhestvo Rude Armady
China	Beijing Institute of Chemical Metallurgy Dalian Institute of Chemical Physics
Russia and other NIS	All-Union Scientific Research Biotechnology Institute Livani Biochemical Plant Shebekino Biochemical Plant
South Korea	Doosan Manufacturing Co.
(Former) Yugoslavia	Livani Biochemical Plant Shebekino Biochemical Plant

Source: The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government, 1995), 37-39.

APPENDIX E

PROBABLE WORLDWIDE MANUFACTURERS OF CENTRIFUGAL SEPERATORS

(AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Australia	Beckman Instruments Pty, Ltd.
Austria	Heraeus Wien Westfalia Separator Austria GmbH
Denmark	6V Separation AS Alfa-Laval Separation AS
France	Alfa-Laval SA Beckman Dupont de Nemours SA Jouan SA
Germany	Alfa-Laval Industrietechnik GmbH Heracus-Christ Separationstechnik GmbH Heraeus-Sepatech GmbH Kontron Instruments GmbH
Italy	Alfa-Laval SpA Beckman Analytical SpA Dupont de Nemours Italiana SpA
Japan	Alfa Laval K.K.
Netherlands	Labinco BV Lameris Laboratorium
Norway	Heigar & Co. AS Nyegaard & Co. AS
Sweden	Bergman & Beving AB
Switzerland	Alfa-Laval Industriegesellschaft AG Dr. Bender & Dr. Hobein AG Heraeus AG LSL Secfroid SA Treff AG
United Kingdom	A. R. Horwell, Ltd. Alfa-Laval Engineering, Ltd.

APV Chemical Machinery, Ltd.
Baird & Tatlock, Ltd.
Burkard Scientific, Ltd.
Camlab, Ltd.
Centrilab
Damon/IEC, Ltd.
Denley Instruments, Ltd.
Dupont (UK), Ltd.
Eltex of Sweden, Ltd.
Hawksley & Sons, Ltd.
Jouan, Ltd.
MSE
MSE Scientific Instruments
Nycomed, Ltd.
Nygaard (UK), Ltd.
Sarstedt, Ltd.
Simsons of Edinburgh, Ltd.
V. A. Howe & Co., Ltd.
Zeta Engineering, Ltd.

OTHER WORLDWIDE MANUFACTURERS OF CENTRIFUGAL SEPARATORS

(AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Belgium	Sanki Engineering, Ltd. Sweco Europe SA
Canada	Sarstedt Canada, Ltd.
Finland	Finn Metric OY
France	Guinard Centrifugation Knontron NEN France Sarl Rousselot Ets
Germany	AMKO Light Technology Instruments GmbH Andreas Hettich Berthold Hermle GmbH Carl Padberg Zentrifgenbau GmbH Electro-Nucleonics International, Ltd. Eppendorf-Netheler-Hinz GmbH Hettich-Zentrifgen Industrienlagen AG Wimmer GmbH Zirbus-Verfahrenstechnik
Italy	Hewlett Packard Italian SpA
Japan	Fuji Filter Manufacturing Co., Ltd. Hitachi Koki Co., Ltd. Mitsubishi Kakoki Kaisha, Ltd. Nippon Atomic Industry Group Co. Shinmaru Enterprises Corp.
Netherlands	Amsterdam Valve & Fitting BV Pijttersen BV
Portugal	Elnor
Spain	Hucoa-Erloss SA

(NON-AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Malaysia	Juru Rubcoil Sdn Bhd

Russia	Moscow Production Institute of the Food Industry All-Union Scientific Research and Experimantal Design Institute of the Food Machine Building Industry
South Korea	Han Seong Machinery Manufacturing Co. Korea Storage Battery Co.
Taiwan	Bestway Corp. Chang Jung Business Company, Ltd. Sui Sheng Refrigeration Engineering Co. Yau Yuan Industrial Machinery Co.
Ukraine	Kharkov Institute of Mechanization and Electrification of Agriculture

** Israel and the Republic of South Africa posseses the technological knowledge, industrial capability, and infrastructure support to produce the most advanced centrifuges.

** India, Brazil, and Pakistan are also potential producers.

Source: The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government, 1995), 39-40.

APPENDIX F

CONFIRMED WORLDWIDE MANUFACTURERS OF FREEZE DRYERS

(Manufacturers Capable of Producing Units Over 1,000 Liters per Batch Capacity)

(AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Finland	Finn-Acqua Corp. (Owned by AMSCO)
France	Cellier CIRP/Serail Usifroid S. A.
Germany	Leybold-Heraeus GmbH (Owned by AMSCO)
United Kingdom	Edwards High Vacuum Intl. (British Oxygen) (Owned by AMSCO)

UNCONFIRMED WORLDWIDE MANUFACTURERS OF FREEZE DRYERS

(AUSTRALIAN GROUP)

COUNTRY	MANUFACTURER
Austria	Labin Reichert-Jung
Denmark	Atlas (Manufactures automated tray loading freeze dryers for the food industry)
France	Biolafitte Froilabo Biomedical Group S. G. D. Heraeus Hibbon Intl. Rua Instruments
Germany	Alb. Klein GmbH Martin Christ GmbH & Co., KG. Polimex
Italy	Edvards Alto Vuoto
Japan	Osaka Gas
Netherlands	Grenco BV
Portugal	Cassel Industries
Spain	Telstar S. A.
Switzerland	Salvis
United Kingdom	Tech

(NON-AUSTRALIAN GROUP)

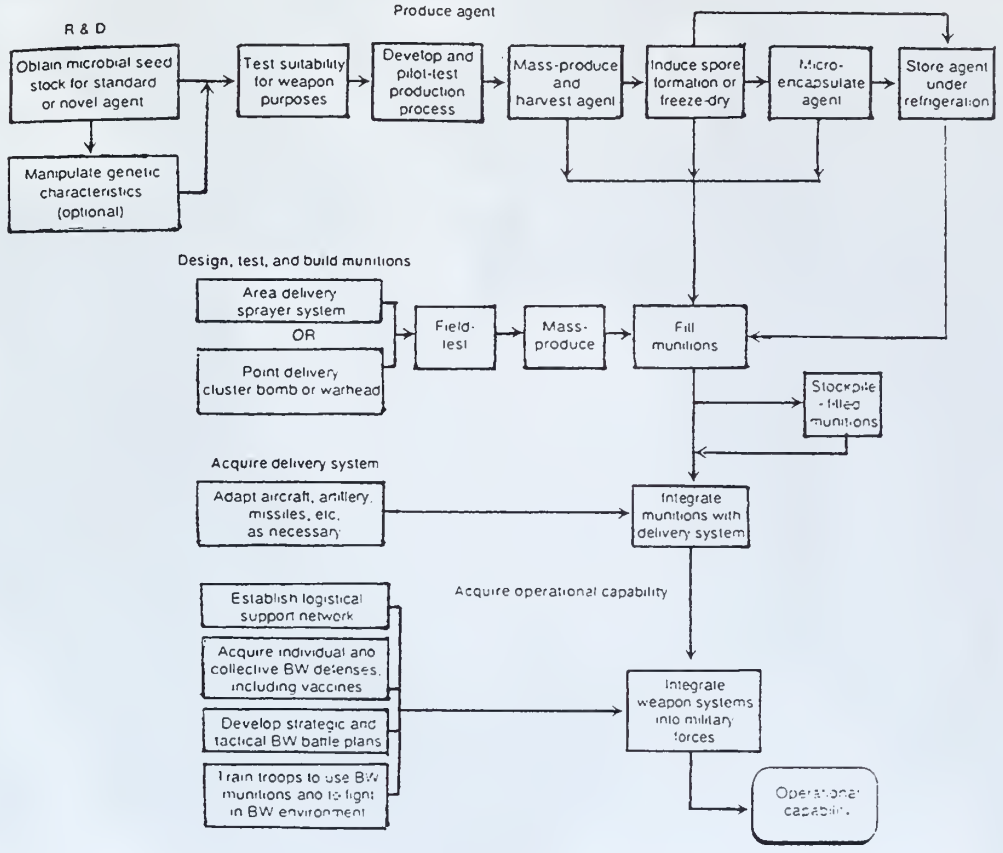
COUNTRY	MANUFACTURER
India	Aircons Pvt., Ltd. Coil Company, Ltd. Ice-King Refrigeration Engineering Ice & Diesel Engineering Works Super Refrigeration, Ltd.
Israel	Polipach, Ltd.

Malaysia	Juru Rubcoil Sdn Bhd
Poland	Polimex-Cekop
China	Changchun Pneumatic Components
Singapore	Associated Instrument Mfg. (S), Ltd. O.S.L. Sinko
Taiwan	Bestway Corp. Chang Jung Business Co., Ltd. Fu Sheng Ind Co., Ltd. Sui Sheng Refrigeration Eng. Co. Yau Yuan Ind Machinery Co., Ltd.
Russia and other NIS	Institute of the Problems of Cryobiology and Cryomedicine

Source: The Chemical and Biological Warfare Threat. (Washington, D.C.: U.S. Government, 1995), 40-41.

APPENDIX G

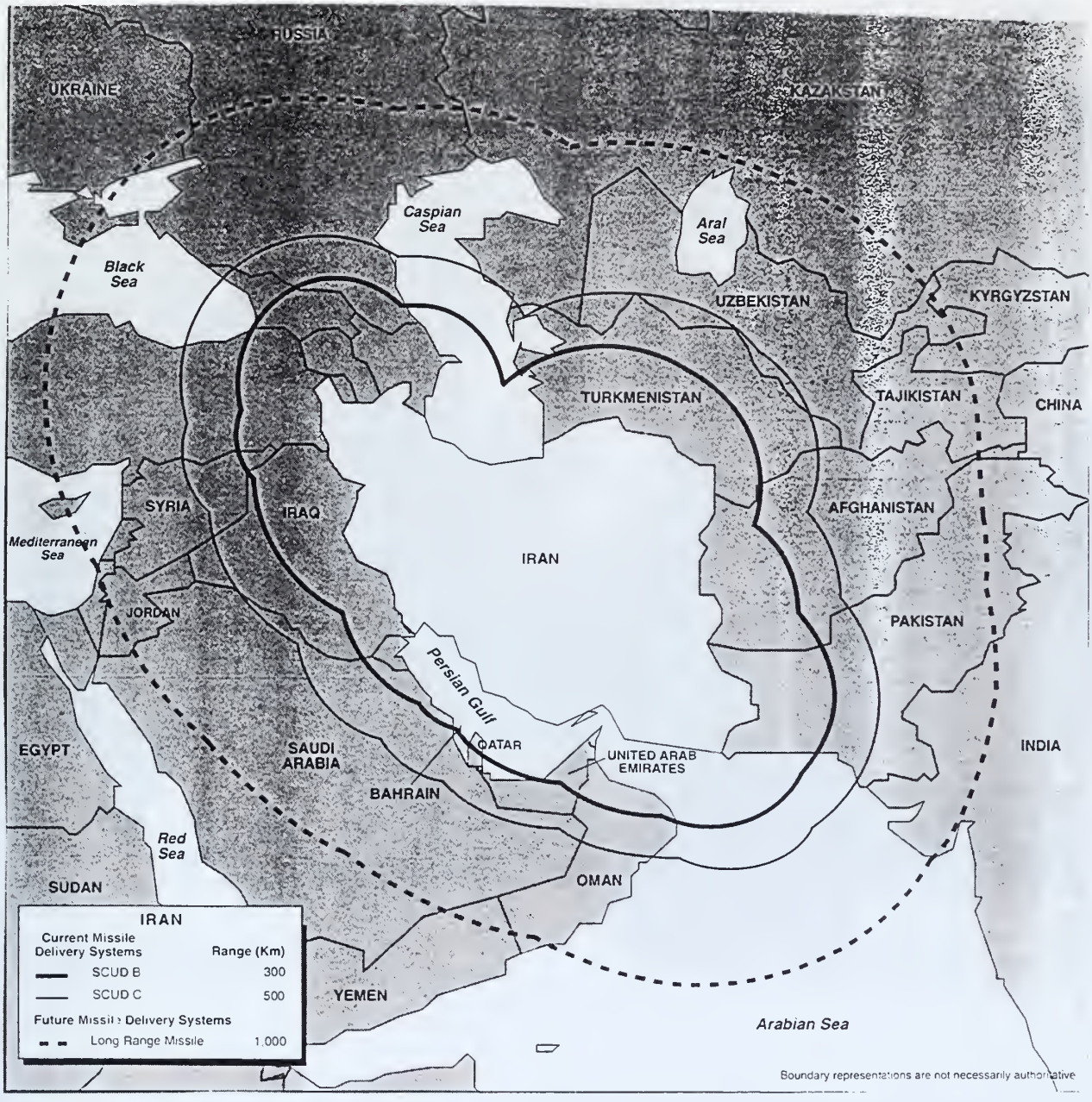
POSSIBLE STEPS TO ACQUIRE A MILITARY BIOLOGICAL OR TOXIN WEAPON CAPABILITY



Source: U.S. Congress, Office of Technology Assessment, Technologies Underlying Weapons of Mass Destruction, OTA-BP-ISC-115 (Washington, D.C.: U.S. Government Printing Office, December 1993), 83.

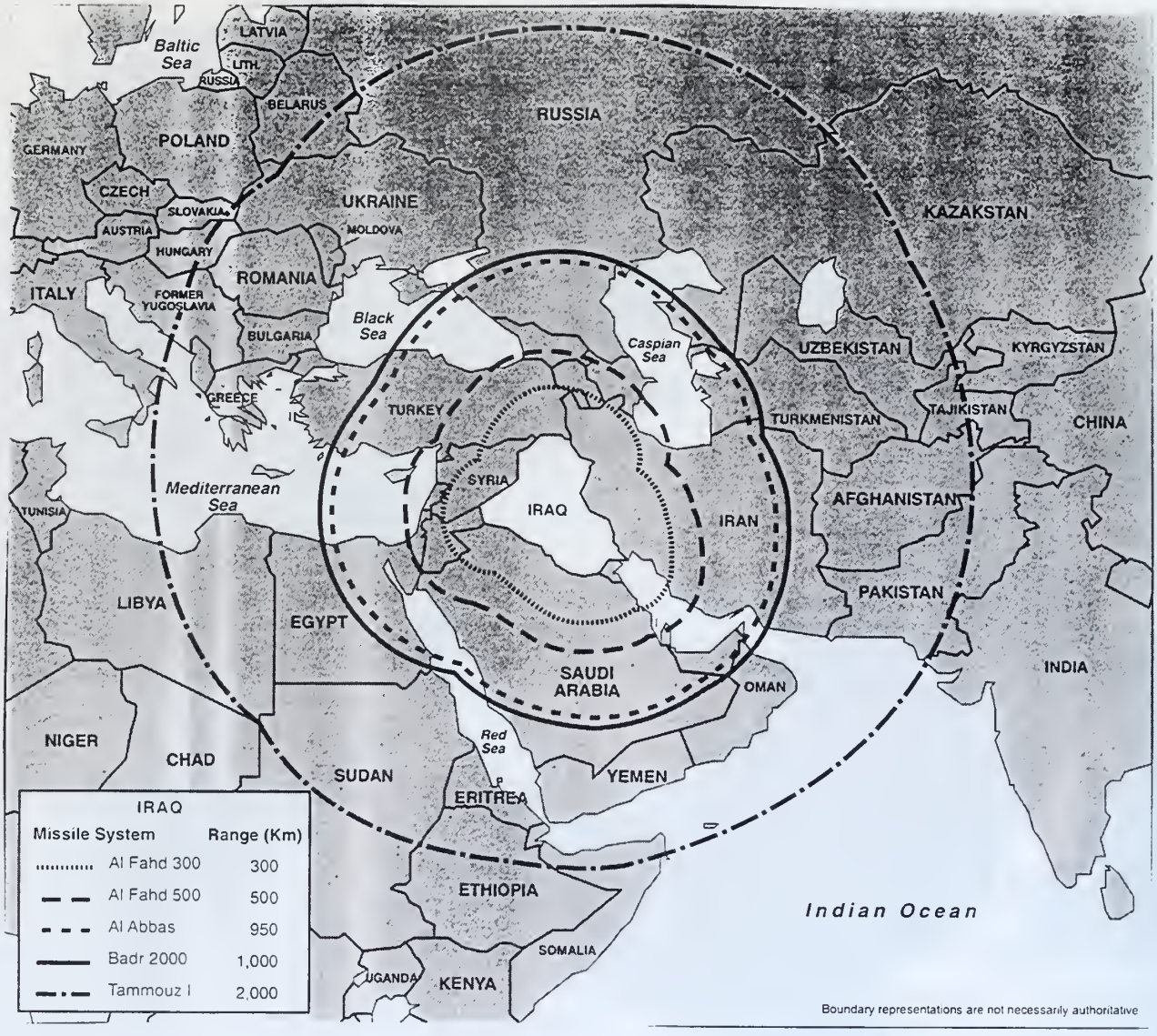
APPENDIX H

RANGES OF CURRENT & FUTURE IRANIAN BALLISTIC MISSILES



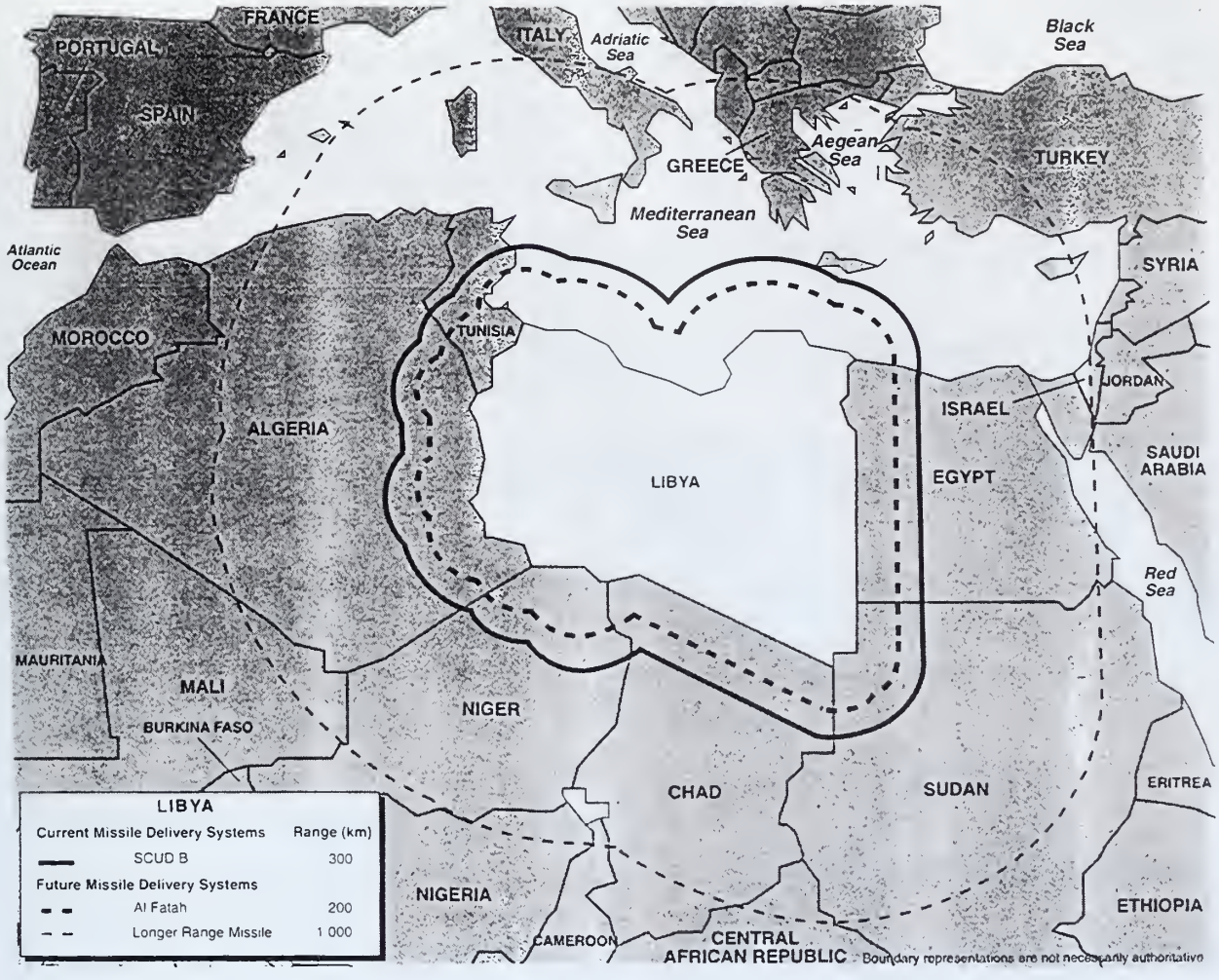
Source: Office of the Secretary of Defense. Proliferation: Threat and Response (Washington, D.C.: U.S. Government Printing Office, April 1996), 17.

RANGES OF IRAQI BALLISTIC MISSILES IN DESIGN OR R&D PRIOR TO OPERATION DESERT STORM



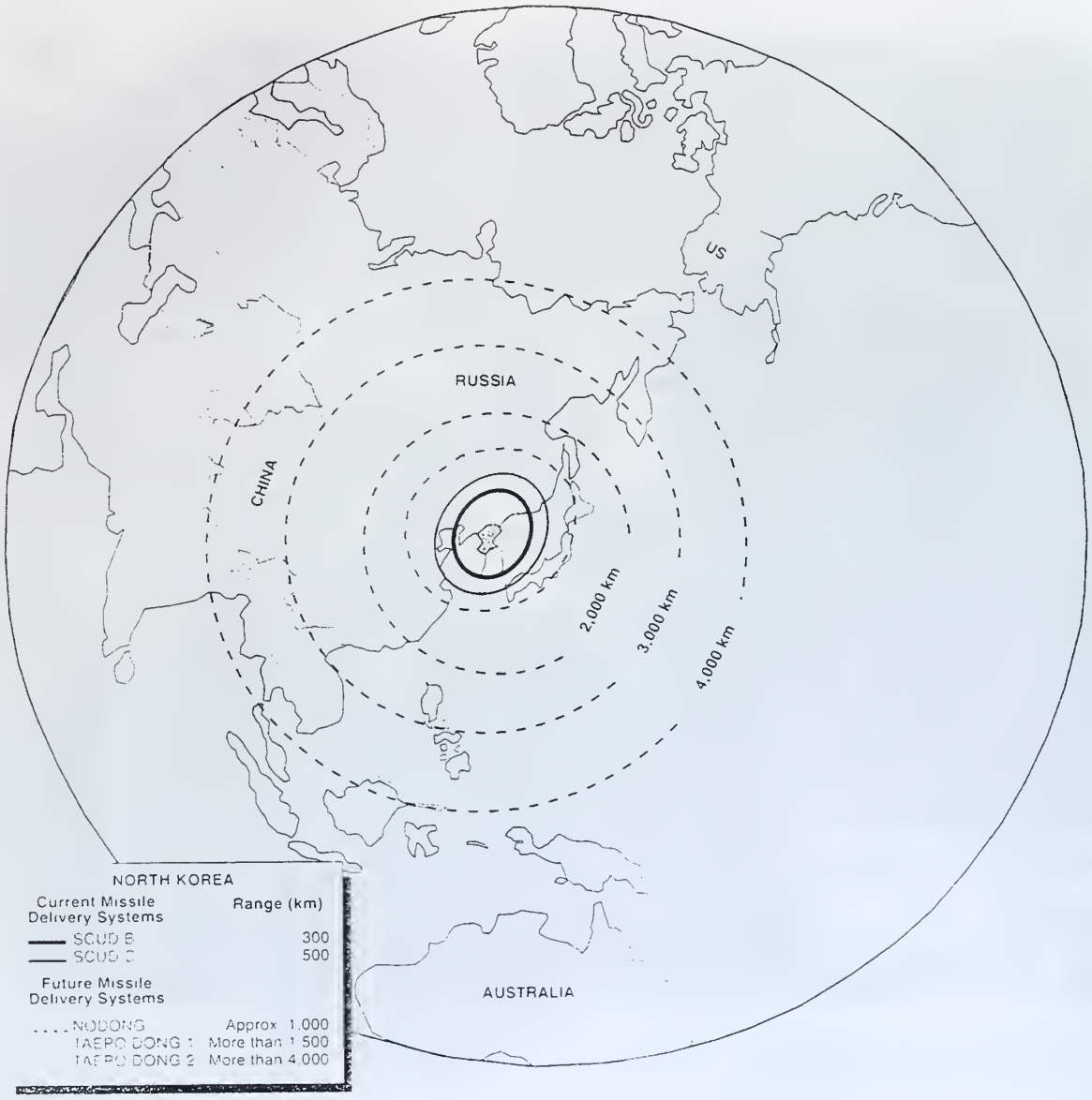
Source: Office of the Secretary of Defense. Proliferation: Threat and Response. (Washington, D.C.: U.S. Government Printing Office, April 1996), 22.

RANGES OF CURRENT & FUTURE LIBYAN BALLISTIC MISSILES



Source: Office of the Secretary of Defense. Proliferation: Threat and Response. (Washington, D.C.: U.S. Government Printing Office, April 1996), 28.

RANGES OF CURRENT & FUTURE NORTH KOREAN BALLISTIC MISSILES



Source: Office of the Secretary of Defense. Proliferation: Threat and Response. (Washington, D.C.: U.S. Government Printing Office, April 1996), 8.

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